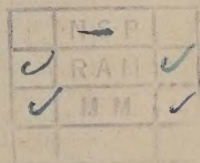




REPORT
OF THE
Department of
Scientific and Industrial
Research

FOR THE YEAR ENDED
31 MARCH 1960

Presented to the House of Representatives by Leave



BY AUTHORITY:

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MINISTER'S STATEMENT

THE reports of the Department of Scientific and Industrial Research and of the Council of Scientific and Industrial Research for the year ended 31 March 1960 are presented herewith.

I wish to record my appreciation of the work of members of the Council of Scientific and Industrial Research who have given generously of their time to matters of scientific policy, reviewing the work of the Department, and fulfilling their other functions under the Scientific and Industrial Research Act. I wish to thank Dr J. F. Filmer and Dr J. S. Watt who completed their terms of office and to welcome Dr I. J. Cunningham and Mr K. E. Seal who were appointed to succeed them.

In the course of the Department's work in the Antarctic a serious accident took place, resulting in the loss of life of one of the party and injury to others. I very much regret this happening and wish to take this further opportunity to express my sympathy to the next of kin of Lieutenant T. Couzens and to those who suffered injury. I should like here also to record my thanks and indebtedness to Rear Admiral David Tyree, Commander, U.S. Naval Support Force, Antarctica, for his prompt assistance in arranging a special flight to convey the injured back to New Zealand.

Because of the rapidly changing needs for research in both agriculture and manufacturing, the Council of Scientific and Industrial Research has made a study of the Government Research Organisation and has made some recommendations. The whole subject is being examined by the Government, but in view of the complexities and the nature of the issues involved, it is not a matter which can be decided without careful investigation.

A committee to coordinate wool research, now being supported by the New Zealand Wool Board and the Department of Scientific and Industrial Research, and to advise on the future organisation and scope of research on wool has been established as a committee of the Council of Scientific and Industrial Research. I particularly welcome this move and trust it will lead to the development of wool research in keeping with the importance of wool in New Zealand's economy and to enable it more effectively to meet the ever-growing competition from synthetic fibres.

I am pleased to be able to report substantial progress in the provision of better accommodation for some branches of the Department. A new building for the Botany Division is nearing completion at Lincoln and construction is now under way of the new Soil Bureau building at Taita and of the remaining buildings to house the Dominion Laboratory at Lower Hutt. In addition, detailed plans and specifications are being prepared for the Plant Physiology Unit and for additions to the Grasslands Division building, both at Palmerston North.

I should like to thank the staff of the Department and to record my appreciation of their work during the year.

P. N. HOLLOWAY,
Minister in Charge of the Department of
Scientific and Industrial Research.

REPORT OF THE COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The Hon. P. N. HOLLOWAY, Minister in Charge of the Department of Scientific and Industrial Research.

We have the honour to submit herewith the report of the Council of Scientific and Industrial Research for the year ended 31 March 1960.

The Council consists of a chairman and not more than eight other members, not more than two of whom may be "officers employed in the service of the Government." The membership of the council at 31 March 1960 was:

M. M. Burns, C.B.E., M.Sc.(N.Z.), Ph.D.(Aberdeen), F.N.Z.I.C. (Chairman).

F. J. Llewellyn, Ph.D., D.Sc.(B'ham), F.R.I.C., F.N.Z.I.C., F.R.S.A. (Deputy Chairman).

J. Andrew, C.B.E.

I. J. Cunningham, C.B.E., M.Sc.(N.Z.), Ph.D.(Aberdeen), B.V.Sc.

A. F. Downer, C.B.E., M.I.C.E., M.N.Z.I.E.

C. Hilgendorf, M.A.

K. E. Seal, M.Sc.(London), A.N.Z.I.C.

R. Slade.

A. H. Ward, A.R.A.N.Z.

W. M. Hamilton, M.Agr.Sc., D.Sc., N.D.H.(N.Z.) (Secretary).

Dr J. F. Filmer and Dr J. S. Watt retired on rotation on 31 December 1959 and the vacancies were filled by the appointment of Dr I. J. Cunningham and Mr K. E. Seal for a period of four years from 1 January 1960.

Five meetings of the Council were held during the year, and its various committees met regularly. The Council wishes to take this opportunity of expressing its appreciation of the valuable work done by members of its committees.

REVIEW OF DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH ACTIVITIES

During the last two years, panels of Council members have visited all the branches of the Department of Scientific and Industrial Research and examined their staffing, programme of research, accommodation, and budgets. In preparation for such visits the directors of research units have prepared and circulated to us detailed surveys of their current programmes and the projected development and staffing of their units. We have discussed these with Dr Hamilton and his Assistant Secretaries both at the time of our visits to branches and in succeeding Council meetings.

As an outcome of these visits and discussions we are agreed:

(1) On the general high scientific calibre of the research staff employed and their enthusiasm for their work, and the close cooperation which exists with workers in other Departments and organisations.

(2) On the high quality of the research being undertaken and its close relationship to the problems of the industries being served.

(3) That in most branches there is a satisfactory and desirable balance of *ad hoc* and basic long-term research being undertaken; in a few units, however, basic research could with advantage be strengthened.

(4) That over the last decade the number of scientific staff employed in the Department has remained virtually static while New Zealand's population and total labour force have increased by approximately 22 per cent and 18 per cent respectively. This static position has been occasioned primarily by lack of finance to employ and service larger numbers.

(5) That during this period there has been considerable reorientation of the work of the Department, some activities being curtailed to provide necessary staff for new developments such as nuclear science, oceanography, geothermal, and Antarctic activities. In present circumstances there is virtually no further scope for adjustments of this type.

(6) That, because of limitations of finance and staff, the Department has been unable to exploit fully the scientific opportunities to assist both primary and manufacturing industry. Various phases of the Department's work also need strengthening. In a number of cases, e.g., metallurgy and chemical engineering, there are only one or two qualified specialists dealing with a wide range of problems of great national importance such as geothermal investigations, iron and steel developments, etc.

(7) That the full implementation of the present programme of work of the Department will require an increase of 40-50 staff per year.

(8) That the full implementation of the present programme in D.S.I.R. is estimated to cost at 1959 prices and salary scales:

			Estimated Expenditure at 1959 Prices (£000)		
			Salaries	Other Expenditure	Total
			£	£	£
1959-60	..	..	1,016	796	1,812
1960-61	..	..	1,100	990	2,090
1962-63	..	..	1,200	933	2,133
1964-65	..	..	1,280	985	2,265

If costs or salary scales increase above 1959 levels these figures would need adjusting accordingly.

(9) That the accommodation provided for research units is extremely variable in quality and substantial new building is required to house all units at a reasonable standard. We strongly urge that provision be made for approximately £200,000 per annum on Public Works Account for D.S.I.R. buildings for the next five years.

(10) That, if the Department is to be equipped to take advantage of scientific developments overseas and use them to the national advantage, Government must be prepared to purchase some major pieces of capital equipment in the next few years, e.g., a small nuclear reactor and an electronic computer. The cost of these major items of equipment would be additional to the figures given in 8 above.

Research is a long-term venture. From the time a decision is made to embark on a new field of research it may easily take 5-10 years for recruitment of suitable staff, their overseas training in the new field, and provision of laboratories and equipment before the work can get really under way. Nuclear science is a good example. Firm proposals were first placed before Government in mid 1956 and it is anticipated that the first major piece of equipment will not be installed and operating before the end of 1961 or early 1962. Long-term planning is therefore involved in the ordered development of research and this must be accompanied by long-term planning of financial support.

We have carefully considered the role which science must fill in a rapidly developing economy such as ours. We would emphasise the need to investigate fully our resources and give every assistance to primary and manufacturing industries if we are to sustain or improve the standard of living of a population projected to reach 3 million in the early 1970's and 4 million by the late 1980's.

We would point out that the cost of the recommended increases in the level of scientific effort is small when compared with the dividends research pays. To quote just one recent example: two new varieties of wheat were released recently by the Crop Research Division. After a careful survey following the 1959 harvest it is estimated that these two new varieties increased yields by a total of 623,300 bushels, worth, at 13s. 6d. a bushel, £420,700.

In the 1960 harvest the two new varieties, Aotea and Arawa, were sown on nearly 90 per cent of the wheat acreage. The increased yield over Cross 7 (the variety replaced) is estimated at $1\frac{1}{2}$ million bushels, worth, at 13s. 6d. a bushel, approximately £1 million. This annual return from one section of the work of the Crop Research Division represents far more than the total expenditure by the Division (approximately £650,000) since its establishment 24 years ago.

ORGANISATION OF RESEARCH

After full consideration of the problems of research organisation in New Zealand, the Council of Scientific and Industrial Research is convinced that maximum efficiency and coordination in Government-funded research would be achieved by the establishment of a National Research Organisation as an independent organisation responsible for the main research functions of Government. Such an organisation should be a body corporate employing its own staff and should submit an annual report to Parliament and receive an annual appropriation of funds.

New Zealand is facing the research problems associated with an increased tempo of national development. While reorganisation along the lines suggested will not lead to any reduction in research expenditure, it is the considered view of Council that the establishment of a National Research Organisation to replace the present D.S.I.R. should lead to greater efficiency, to better coordination in existing research programmes, and provide greater flexibility in organising programmes to meet future needs.

COOPERATION WITH THE UNIVERSITY

Council notes with satisfaction the increasing cooperation between the University and D.S.I.R. For many years now there has been close interchange of ideas and facilities at the professional level, but it is only recently that formal arrangements for cooperation have been made.

The approval to provide accommodation for the Applied Mathematics Laboratory in the new library block at the Victoria University of Wellington and the proposed establishment of a Sedimentation Laboratory jointly by the Geological Survey and the University within the buildings of the University of Canterbury augurs well for the future. Council is considering other ways in which this formal cooperation may be extended, including the siting of various divisions in close proximity to University departments as and when building becomes possible.

SALARIES OF SCIENTISTS

The need for a thoroughly adequate review of professional salaries within the Department is now more urgent than ever. Qualified technological personnel have an employable value throughout the world, probably unequalled in other professions, and adequate adjustments in salary scales for the Department are essential to prevent unnecessary dissatisfaction and consequent serious loss of staff and efficiency.

Council of S.I.R. are concerned with the maintenance of the Department's position in the leadership of scientific research within the Dominion. Such leadership is always conditional on employment of highly qualified staff, enthusiastically pursuing their particular scientific endeavours, and capable of attracting junior staff similarly inspired.

Council has reported its confidence in the calibre and quality of work of the officers of the various divisions of the Department, and consequently has a duty and responsibility to draw attention to the serious position facing the whole of the Department's endeavours unless the present staff can be retained and recruits of equal calibre be attracted to the Department. Plans have already been formulated for a considerable speeding up and intensification of technical developments in new and established industries, both primary and secondary. This, in turn, will make new demands on scientific knowledge and service. The Department has good scientific leaders competent to cope with the problems

of expanding industry but must increase its professional staff and maintain the same high standard of recruitment which it has set in recent years. It must again be emphasised that success in these spheres will depend upon satisfactory and competitive conditions of employment within the Department.

RESEARCH EXPENDITURE

D.S.I.R. expenditure since 1949-50 is shown in the summary below, together with a column showing expenditure as a percentage of the gross national product (national income).

Year	Staff at 1 April		Gross Expenditure	Gross National Product	D.S.I.R. Expenditure as Percentage of National Product
	Professional	Total			
			£(000)	£(m.)	
1949-50	363	939	959	553	0.173
1950-51	390	981	962	697	0.138
1951-52	386	997	1,096	723	0.152
1952-53	402	1,012	1,010	758	0.133
1953-54	374	931	1,089	842	0.129
1954-55	374	937	1,149	932	0.124
1955-56	372	928	1,213	986	0.123
1956-57	366	946	1,404	1,029	0.137
1957-58	369	972	1,535	1,084	0.142
1958-59	383	1,023	1,658	1,137	0.146
1959-60	390	1,067	1,812	*	*

*Figures not available.

RESEARCH GRANTS TO BODIES OUTSIDE THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The Council continues to recommend annual grants to research workers in the universities and to other institutions to encourage research, frequently in subjects ancillary to the main programme of the Department of Scientific and Industrial Research.

Each of the two agricultural colleges has, for instance, received grants of from £6,000 to £9,000 annually for some years to support research into a large number of problems concerned with soils, farm plants, and animals.

At the universities the Council supports with substantial grants a number of research projects such as radio research at Auckland, research into meteor showers at Canterbury, and the Industrial Development Department of the University of Canterbury. At Victoria University of Wellington it has met a considerable part of the cost of the special investigations of ironsands.

The grants to universities, including the colleges of agriculture, have for some years amounted to approximately £30,000 annually and moneys so spent enable a large amount of research to be carried on by members of university staffs and others who would be severely handicapped in their work without this aid.

In addition to those for university research, grants are made to allied institutions, to research institutions, societies, and associations. At the Cawthron Institute in Nelson and at the seven incorporated research associations such grants provide approximately half the total funds available.

Altogether, including grants to universities, research institutions, and otherwise, the Council of Scientific and Industrial Research recommends annually the expenditure of a substantial sum, this year over £172,000, to assist research or the work of organisations concerned with research. These grants, although met from the vote of the D.S.I.R., are outside the regular programme of research and scientific services of the Department itself.

Details of grants paid last year are as follows:

Grants Paid in 1959-60 to Research and Allied Institutions

	£	£
Canterbury Agricultural College	8,500	
Massey Agricultural College	9,000	
University of Auckland (Seagrove)	4,000	
University of Canterbury—		
Industrial Development Department	8,000	
Radio Research (Meteors)	1,550	
Victoria University of Wellington—		
Ironsands Investigations	3,140	
		34,190
Cawthron Institute		11,300
Carter Observatory—		
Statutory	2,250	
International Geophysical Year	596	
		2,846
Royal Society of New Zealand		5,000
Commonwealth Agricultural Bureaux		18,680
U.K. National Institute of Oceanography		2,500
C.A.S.A.G.I. (IGY controlling body)		250
Royal Society and Nuffield Bursary Scheme		200
Scott Polar Research Institute		200
International Conference of Soil Science		500
British Association of Scientific Instrument Makers		120
International Atomic Energy Agency		7,306
Dr Elizabeth Flint, Soil Investigations		380
Dr G. H. Cunningham		1,000
Incorporated Research Associations—		
Dairy Research Institute (N.Z.)	34,625	
Meat Industry Research Institute of New Zealand (Inc.)	23,400	
New Zealand Fertiliser Manufacturers' Research Association (Inc.)	4,500	
New Zealand Leather and Shoe Research Association (Inc.)	6,860	
New Zealand Pottery and Ceramics Research Association (Inc.)	6,200	
New Zealand Wool Industries Research Institute (Inc.)	7,215	
Research Institute of Launderers, Drycleaners and Dyers of New Zealand (Inc.)	5,000	
		87,800
		<u>£172,272</u>

DEPARTMENT EXPENDITURE AND STAFFING

Expenditure by the Department in 1959-60 is shown in the table below:

Table of Expenditure 1959-60

	Staff 31 March 1960	Salaries	Other Expenditure	Total Expenditure 1959-60	Voted 1959-60
		£	£	£	£
Head Office	71	62,336	12,761	75,097	75,800
Animal Ecology Section ..	8	7,508	3,505	11,013	12,100
Applied Mathematics Laboratory	19	19,274	1,970	21,244	20,960
Auckland Industrial Development Laboratories	34	33,759	10,908	44,667	46,090
Botany Division	25	25,199	11,231	36,430	35,200
Crop Research Division ..	52	44,137	22,696	66,833	65,400
Dominion Laboratory	145	130,016	64,164	194,180	192,500
Dominion Physical Laboratory ..	151	131,261	67,942	199,203	189,500
Entomology Division	29	26,059	12,573	38,632	37,500
Fats Research Laboratory ..	17	15,415	5,750	21,165	21,960
Fruit Research Division ..	28	28,481	24,052	52,533	52,400
Geological Survey	86	75,091	27,659	102,750	96,500
Geophysics Division	70	67,404	43,802	111,206	113,500
Grasslands Division	82	63,171	44,907	108,078	105,600
Hop Research Station	5	4,121	3,137	7,258	7,900
Information Bureau	22	20,183	39,271	59,454	59,960
Institute of Nuclear Sciences ..	27	25,710	41,075	66,785	66,500
Oceanographic Institute	24	20,957	30,618	51,575	48,200
Plant Chemistry Division ..	29	25,194	12,454	37,648	37,000
Plant Diseases Division	66	59,579	30,405	89,984	87,400
Scientific Liaison Service ..	6	9,660	4,314	13,974	14,800
Soil Bureau	77	73,791	31,721	105,512	102,650
Tobacco Research Station	7	6,108	3,870	9,978	9,780
Wheat Research Institute	11	11,871	2,036	13,907	13,150
Research General	..	..	10,177	10,177	10,800
Scholarships	..	..	11,236	11,236	10,500
Miscellaneous	..	..	418	418	500
Grants—					
Universities and agricultural colleges	..	..	34,190	34,190	32,550
Incorporated research associations	..	..	87,800	87,800	87,905
Statutory and miscellaneous ..	..	..	50,282	50,282	49,645
Antarctic Division	30	30,141	48,465	78,606	71,750
	1,121	1,016,426	795,389	1,811,815	1,776,000
Less recoveries	..	..	..	46,081	50,780
Net expenditure	..	..	..	1,765,734	1,725,220

The actual staff employed on 31 March 1959 was 1,065 and by 31 March 1960 this had increased to 1,121.

The staff at 31 March 1960 (figures for previous year in parentheses) comprised professional 401 (390); clerical 180 (175); technical 470 (435); others 70 (65).

M. M. BURNS, Chairman.

SECRETARY'S REPORT

The Hon. P. N. HOLLOWAY, Minister in Charge of the Department of Scientific and Industrial Research.

I HAVE the honour to submit herewith the annual report of the Department for the year ending 31 March 1960.

In February 1958, Government approved a continuing programme of research in the Antarctic after completion of the International Geophysical Year. It then became desirable to make more permanent administrative arrangements than were necessary for a relatively short-term project like the IGY. With your approval the Department last year established an Antarctic Division to be responsible for the execution and operation of New Zealand scientific activities in the Ross Dependency and to maintain an information centre on Antarctic research and exploration.

Despite all the technical advances which have been made in recent years, work in the Antarctic is still fraught with personal danger. During survey activities in the Ross Dependency this year, a sno-cat fell through a snow bridge over a crevasse near Cape Selborne resulting in the death of Lieutenant T. Couzens and serious injury to the party's two geologists, B. M. Gunn and J. Lowery. The Department extends its deepest sympathy to the next of kin of Lieutenant T. Couzens. We are greatly indebted to Rear Admiral David Tyree, Commander, U.S. Naval Support Force, Antarctica, for his prompt assistance in rescue operations and for making a special flight to convey the injured back to New Zealand—also for air support in repositioning our survey parties after the accident.

During the year an officer of the Department, Mr T. A. Rafter, was appointed Director of the new Institute of Nuclear Sciences. Mr G. J. Fergusson of the Institute was given special leave to accept the invitation of a one year appointment to the specialist secretariat of the United Nations Committee on Radioactive Fallout. In November an order was placed for a 3 MeV Van de Graaff accelerator as the first major piece of equipment for the Institute and delivery is expected in mid 1961. Sketch plans of the accelerator building and associated laboratories and administrative block have been prepared and drillings to test foundations have been made on possible sites for the Institute.

Buildings are under construction at Gracefield to complete the transfer of Dominion Laboratory from the Sydney Street site and it is anticipated the shift can be made later this year. Tenders were also let for a new building for Soil Bureau at Taita and construction is well under way. The Botany Division building at Lincoln is not yet completed some seven months after the contract date.

STAFF

On 31 March, Mr F. J. T. Grigg retired from the position of Director of the Dominion Laboratory after 42 years' service in the Laboratory. Mr Grigg directed the work of the Dominion Laboratory for 13 years, during which the Laboratory played an important role in the application of science to industry. Mr I. K. Walker, previously Assistant Director, has been appointed to the vacancy.

At 31 March 1960 the professional staff of the Department was 401, an increase of 11 during the year and one less than were employed at 1 April 1952. In spite of increasing responsibilities in fields such as geothermal investigations, nuclear science, oceanography, and Antarctic activities, the number of professional staff in the Department has not increased in recent years.

Population in New Zealand is expanding rapidly and volume of total production has increased approximately 40 per cent in the last 10 years. If the Department is to meet reasonable demands on its services, staff numbers must keep pace with the growth of population and national development. It is essential to fully investigate our national resources and give every assistance to primary and manufacturing industries if we are to sustain or improve the standard of living of a population projected to reach 3 million within 15 years and 4 million within 30 years. Rising costs in the last decade have inflated the Department's vote without increasing its ability to undertake research or provide scientific services. If the present programme of work of the Department is to meet reasonable demands, it will require an increase of 40-50 staff per year over the next five years.

RESEARCH

In the following section a brief review of work completed during the year is given. Items that appear to be of general interest have been selected and are outlined in non-technical terms with sufficient background information to explain the significance of the work. No attempt has been made to cover all work completed, but a complete list of all scientific papers published during the year is given following the list of projects in each branch.

PAINTING EXTERIOR WOODWORK

A high proportion of Government buildings, 60 per cent or more, are sheathed with timber which requires protection with paint. State houses, schools, mental hospitals, railway stations, and other departmental buildings represent a very large capital investment. Exterior painting is the largest single item of maintenance involved in the protection of these assets, and durability of the paint therefore assumes considerable economic importance. State Advances Corporation of New Zealand alone spends nearly £200,000 annually on exterior painting.

In 1946 extensive paint failures on State houses led to an investigation of the problem in the Auckland area, and a large-scale programme of tests was initiated by the Dominion Laboratory on paint durability at five localities throughout New Zealand. The investigations showed that poor workmanship and inferior paint quality were prime causes of poor durability and that excessive weathering of priming coats and the dip-treatment method of timber preservation were contributing factors. The promulgation of new standard specifications for exterior oil paints coupled with regular inspection of paints sampled on the building sites did much to improve the standard of paint durability. Durability of specification paints was confirmed by tests on proprietary products. At the same time these tests showed that the use of totara primers on timbers other than totara gave rise to early failure of the paint system.

With diminishing supplies of durable-heart native timbers, increasing use has been made of preservative-treated non-heart rimu, tawa, and radiata pine. In the tests referred to above, it was shown that paint lasted as long on pressure-treated non-heart rimu as it did on heart rimu. Later investigations have shown that paint durability on radiata pine is improved by pressure impregnation with multi-salt preservatives, and decreased slightly by diffusion treatment with boron compounds. The main problem in painting radiata pine is premature failure over knots. Although the number and size of knots can be controlled by selective grading and knot plugging, there are economic limitations to such procedures. A completely satisfactory remedy for failure over knots has not been obtained, but the severity of failure can be reduced by the use of an oil-based aluminium primer which also prolongs the life of the paint over the denser summerwood bands. Tawa presents different problems, since it is a hardwood. True hardwoods have pores and, if these are too large, painting is difficult. The pore diameter of tawa is near the upper limit of paintability.

Tests which have been in progress three and a half years have not yet shown any loss in durability attributable either to the nature of the timber or the method of preservative treatment.

The introduction of alkyd-resin-based finishes (so called "high gloss") for exterior woodwork some six years ago represented a radical departure from the traditional use of lead and lead-zinc-type oil paints. Comparative tests of oil and synthetic finishes over the past five years have shown little difference in protective qualities, but the latter maintain a better appearance, particularly in coastal areas, and are not subject to discoloration by sulphide fumes in polluted atmospheres. Failures with repaint work have stressed the need for more careful attention to surface preparation when using the synthetic finishes.

CORROSION OF METALS BY WHANGAEHU RIVER AND RUAPEHU CRATER WATERS

After the Tangiwai railway disaster of 1953, caused by a lahar flood from Mount Ruapehu, the New Zealand Government Railways Department installed a flood-warning system in an endeavour to prevent a recurrence of such disasters. The system employed metal electrodes exposed to Whangaeahu River waters, arranged to give electrical warning of any rise in the river level. Since permanence and reliability are essential in this warning system, corrosion by the river water had to be taken into account in the design and maintenance of the electrodes. Investigations of the corrosive properties of Whangaeahu River water were therefore carried out by the Dominion Laboratory to assist New Zealand Railways in the design and maintenance planning of the warning system.

During investigation of the 1953 disaster, the Whangaeahu River water was noticed to be highly acid, and very corrosive to common engineering metals. Analyses of the water in subsequent years showed that its acidity varied cyclically from near neutral to highly acid, and could be correlated with seasonal contamination by water escaping from the Ruapehu Crater Lake. Further analyses showed the crater water to be extremely acid. Extensive corrosion tests on a wide range of metals and

alloys were therefore conducted in the crater and river waters. These tests confirmed the highly corrosive nature of both waters, provided quantitative corrosion-rate data for various metals, and showed that only a few metals were adequately resistant to attack by these media.

In addition to its application to design and maintenance of the flood-warning system, the information obtained in this investigation throws considerable light on the reason for the disastrous floods. Floods of the lahar type occurred in the summers of 1861, 1925, and 1953. The seasonal variations of acidity in the river shows that there is a winter ice barrier which melts in summer and releases crater-lake water into the Whangaehu River. It is probable that late thawing, or possibly a period of one or more summers without thawing, would produce conditions favourable for lahar flooding. Warning of the flood hazard could probably be obtained by continuous monitoring of the acidity of the Whangaehu River.

ARSENIC CONTAMINATION FROM TREATED TIMBER

Bacon and smoked fish are cured in natural wood smoke, and this industry is likely to be affected by the modern practice of impregnating timber with poisonous chemicals for protection against rot and insect attack. During the year 1957-58, 105 million board feet of sawn timber were treated with chemical preservatives in New Zealand. More than half of these preservatives contain arsenic. Arsenic is a volatile element, and there appeared to be a danger of it being evolved in the smoke during combustion.

For these reasons, the possible hazards in using sawdust or shavings from arsenic-treated timber in smoke-curing bacon and fish were investigated by the Dominion Laboratory. It was shown that as much as 22 per cent of the arsenic content in the shavings was volatilised during combustion, and that when fish was hung in the combustion chamber close to the fire quantities of arsenic as high as 25 parts/million were absorbed. With bacon a different type of smoking chamber was used, and some of the volatile arsenic was deposited in the smoke ducts between the firebox and smoking chamber. However, sufficient arsenic was still present in the smoke to contaminate the bacon to the extent of 2.3 parts/million, and to penetrate the meat to half its thickness.

It is evident from this study that the use of sawdust or shavings from arsenic-treated timber in smoke curing will cause arsenic deposition in the food, and a consequent toxicity hazard. The Department of Health have been advised, and are taking steps to ensure that arsenic-treated timber is not used in the smoke curing of foodstuffs.

ENGINEERING SEISMOLOGY

The analysis of steel and reinforced-concrete frame structures has been underway at the Dominion Physical Laboratory for some years and is continuing. Currently, the 10-storey library block for Victoria University of Wellington is being examined for the structural designers. This form of analysis, which is carried out on an analogue computer, is a big step forward from the traditional technique of applying what is called a static seismic coefficient. It is still, however, not a full analysis, in that the performance of the structure after it has reached the stage of yielding in a few of its members is not assessed. As this latter stage

will inevitably be reached in a major earthquake, it is highly desirable to be able to assess subsequent performance. The analogue computer at the D.P.L. is being modified so as to allow for multi-storey yield.

The analogue has also been modified to analyse either frame or bearing wall structures or any mixture of both. Some existing bearing wall structures in Wellington have been tested on the analogue. It is apparent that an energy absorption mechanism, such as yield, is just as necessary for this type of structure as for the frame type. Such yield could possibly occur in the foundations.

Foundation performance is seen to have increasing significance and, unfortunately, it is a subject on which no quantitative figures exist. To obtain them would be a costly and lengthy matter but if the subject is not investigated in its quantitative sense by overseas countries it may be desirable to extend our investigations into this field.

STUDY OF THE AURORA

This past year has seen the changeover from the IGY programme of collecting information to that of concentrating effort on certain specific experiments in the auroral field. The New Zealand programme has very largely been carried out at Scott Base, at the joint United States/New Zealand Hallett Station (both on the Antarctic Continent), and at Invercargill, this latter station being the headquarters of the project. However, to a very large extent the Invercargill station has become the key station for the auroral observations stretching right across Antarctica and up through Campbell Island to New Zealand.

The New Zealand auroral programme is being assisted by a contract from the Air Force Cambridge Research Centre of the United States. This contract is to enable the results obtained to be analysed and assessed more speedily than would otherwise be possible.

A major addition to the equipment in use on this programme has been the auroral radar set up at Arrival Heights close to Scott Base. The basic electronic equipment for this has been lent by the United States, but the aerial system and recording equipment was designed and built by the Dominion Physical Laboratory. This will enable ionisation studies to be carried out from "inside" the supposed auroral belt.

The radio propagation experiment using special transmissions from Scott Base through the auroral region is proceeding. The receiving stations for this work are now at Campbell Island, Invercargill, and Wallaceville (near Wellington).

The unmanned automatic observatory set up near Becks in Central Otago has operated for a year and has demonstrated that conditions there are greatly superior for all aspects of the optical work. This is not only in freedom from cloud cover, but also, under clear sky conditions in freedom from haze and atmospheric light scattering. Accordingly it is hoped to move all the photographic and spectroscopic work of Invercargill up to a new station fairly close to the existing temporary observatory near Becks.

Amongst the work carried out by the Invercargill team this year it is worth noting that there has been a significant contribution to the

study of the Van Allen Radiation belts. These belts of intense ionisation presumed to encircle the earth have been the subject of a lot of work recently because of the data collected by American and Russian satellites and space vehicles, and they are believed by some workers to be closely associated with the aurora. In addition to this work, analyses of data obtained at Invercargill have brought to light several new facts concerning the aurora that were heretofore unsuspected, which do not fit in with some of the established theory. This work represents a significant advance in knowledge on the subject.

RADIO PROPAGATION PREDICTION

The Geophysics Division maintains five vertical-sounding ionosphere stations, each an essential link in the world-wide network which provides basic data for prediction of long-term changes in the ionosphere so vital to short-wave radio communication. The New Zealand stations at Rarotonga, Godley Head (Christchurch), Campbell Island, Hallett Station, and Scott Base extend from tropical to Antarctic latitudes and have a unique latitude and longitude coverage in the world system, which gives data obtained from them a high intrinsic value.

The vertical-sounding network is designed for scanning the ionosphere at strategic geographic locations by vertical transmission of pulses, and reception after reflection from the ionised regions of the ionosphere extending from 60–300 kilometres above the earth's surface. In this way a continuous record of ion densities and heights of the ionospheric layers is obtained and predictions can be made of future behaviour patterns. The ionised regions vary considerably in behaviour from day to night, seasonally, and according to sunspot cycle as well as according to geographic and geomagnetic location. The successful prediction of these variations is responsible for the present efficiency of short-wave communication, which is so essential in our modern economy not only for radio transmission and reception within a country and between countries, but also in sea and air transport.

In addition to diurnal, seasonal, solar cycle, and location changes, the behaviour of which are predictable, the ionosphere is subject to violent spasmodic variations which create havoc on communication circuits. These are more frequent and severe at sunspot maximum and are associated with intense magnetic storms and aurorae. The primary source of trouble is emanation of radiation from a solar flare in an active sunspot group. The first manifestation results from ultraviolet-light radiation from the flare ionising the lower ionosphere and causing absorption of radio waves there resulting in a fadeout which may last from a few minutes up to several hours. From one to three days later the storm itself follows. More slowly moving particles from the flare source reach the upper regions causing rapid changes in ion densities and heights which can upset reception for several days.

Prediction from New Zealand stations is coded in to the Geophysical Observatory, analysed and distributed very speedily to world prediction centres. Full data for research purposes is published and supplied to research institutions at a later date. In return, New Zealand receives exchange data from stations all over the world and a valuable research library has thus been built up.

As these world-wide predictions are not sufficiently precise for predictions of radio propagation conditions over short distances such as from Wellington to Invercargill, the Geophysical Observatory has made a special study of the New Zealand ionospheric data to meet requests made by the Post and Telegraph Department. Tables of hourly values of maximum usable frequencies (MUF) for short-wave radio transmission over distances of 800 and 3,000 kilometers, were computed from vertical-sounding ionospheric data recorded at Lincoln and Godley Head, Christchurch, for the sunspot cycle 1947-58. For each interval of 10 of running average sunspot number (RASSN) the appropriate MUF can be read. Tables are supplied not only for normal conditions, but also for average calm and average disturbed days.

Used in conjunction with a predicted RASSN these tables give a reliable advance assessment of expected variation of MUF throughout a sunspot cycle. Centred at Christchurch the MUF 800 tables apply particularly accurately to the Wellington-Awarua circuit and will provide a valuable communication aid to the Post and Telegraph Department, New Zealand Broadcasting Service, and Civil Aviation Administration.

During preparation of the tables, a quick method of obtaining MUFs at lower distances than the international standard 3,000 kilometer distance was developed and tables for other shorter distances can now be prepared very speedily by this method should they be required. For very short distances the additional effect of the earth's magnetic field is included.

MAGNETIC COMPASS ADJUSTMENT

Because the earth's magnetic field is not constant throughout the world and also varies from year to year, the magnetic observations throughout the world are responsible for providing the essential data for the revision of the magnetic charts for sea and air navigation purposes. The Geophysics Division provides the data for the south-west Pacific Ocean by operating observatories at Apia (Western Samoa), Amberley (near Christchurch), Hallett Station, and Scott Base (Antarctica), and also by taking observations about every two years at other locations in New Zealand and in the Pacific Islands. During the past two years additional data in the southern oceans and in the Ross Sea has been provided by towing a proton magnetometer behind HMNZS *Endeavour* during her cruises to Antarctica.

Ships and aircraft cannot use these charts adequately for navigation purposes unless their compasses are compensated for the permanent and induced magnetisation produced by the hull, engines, and other ferrous material used in their construction. This is carried out by "swinging" at a site at which the magnetic declination is uniform and at which the value is accurately known. This operation consists of measuring the difference between the true bearing and the magnetic bearing in several directions and compensating the compass until this difference is equal to the magnetic declination in all directions.

During the year observations of the magnetic declination were made for the National Airways Corporation on the aircraft compass-swinging site at Harewood International Airport and several landing compasses were checked for National Airways Corporation at the Amberley

Magnetic Observatory. At the request of the Civil Aviation Administration a detailed magnetic survey was made on the aircraft compass-swinging site at Wellington Airport to ensure that the area was free from magnetic effects due to buried ferro-magnetic materials that might affect the determinations of corrections to be applied to aircraft compasses. A similar magnetic survey was made on a site at the RNZAF aerodrome at Ohakea where aircraft compasses on Canberras are to be checked using the Watts datum compass. Here extreme accuracy is required because the Canberras have doppler aerial arrays and the compass corrections fed in must be accurate to a fraction of a degree. Arrangements are being made for the Watts datum compasses which will be used in this calibration-swinging area to be checked twice a year at Amberley instead of having to be flown to England for testing. During the year several compasses were checked for the School of Navigation at RNZAF station at Wigram.

COSMIC RAY VARIATIONS

Daily density changes in the cosmic ray flux are now being recorded at the Institute of Nuclear Sciences with high resolution telescopes. It has long been known that the intensity of cosmic radiation at a particular place varies during the course of a solar day. During the last five years, measurements made near the earth's magnetic equator and also in New Zealand, have shown that vertical narrow-angle telescopes detect much larger variations, and also show a maximum at a later hour, than do the wide-angle telescopes. An increase in the amplitude of the daily variations is also observed at stations at high altitudes although, in these cases, the maximum is shifted towards earlier hours. The increased amplitude obtained at altitude and with narrow-angle telescopes could be explained by a larger percentage of lower-energy particles being detected at these stations, but the accompanying phase shifts seem to discount this.

To gain additional information on the nature of the daily variational mechanism, five narrow-angle cosmic-ray telescopes – arrayed respectively vertical, 30° west, 30° east, 60° west, 60° east – have been constructed and put into operation. The particle counts from each telescope are automatically added up and printed out each hour. It is expected that after six to 12 months continuous operation the results will shed some light on the origin of these cosmic ray variations.

SEWERAGE TRACING

It has been observed for some time that, under certain conditions, silt from the sewer outfall south of Titahi Bay enters the bay and moves on to the headland or on to the beach east of this. The Institute of Nuclear Sciences was asked by Ministry of Works engineers to develop a technique using radioactive isotopes which would enable the sewerage from this and other outfalls to be traced.

Two questions that had to be answered were, under what conditions does the sewerage enter the bay and, what is the rate of dilution of the sewerage as it moves away from the outfall. The tracer used in this investigation was radio phosphorus which is a beta emitter with a half-life of 14 days and is available in the form of a soluble salt which moreover

occurs naturally in sewerage. Special underwater Geiger-counter detection units that could be operated from a boat, down to a depth of 12 ft, were constructed at the Institute.

Two methods of introducing the isotope were used during the tests. In the first method the radio phosphorus was slowly pumped into the sewer, over a period of hours, prior to its discharge into the sea. In the second method a bottle containing the radio-phosphorus solution was destroyed at a suitable point in the sea. Each test required the use of some 10 curies of radio phosphorus. While the isotope is being fed into the bay the activity of the water in the surrounding area is measured by traversing the area with the launch carrying the underwater detector.

In all, 12 tests have been made, and they indicate that only during a few hours after high tide when the wind is south-west, can the sewerage enter the bay. Under other conditions the sewerage will either move southward along the shore (north-west wind) or move out to sea for a few hundred yards before being swept past the bay by the incoming tide. The minimum dilutions, half a mile from the outlet, are 10,000 times or greater.

TRITIUM IN NATURE

The equipment built for the enrichment and measurement of tritium in natural waters is now operating on a routine basis and two samples per week are being analysed at the Institute of Nuclear Sciences. During the year considerable trouble was experienced with contamination due to the leakage of tritium from adjacent laboratories where it is used as a tracer. This problem was overcome by shifting the enrichment plant to a laboratory at the Geological Survey, Lower Hutt. A new type of electrolysis cell has been developed and put into operation, increasing the efficiency of electrolysis to 100 per cent.

Up to the present 42 samples have been measured, including five tap-water samples, 11 oceanographic samples, 13 Akatarawa Stream samples, and seven from geothermal waters. The oceanic samples from Makara give results consistent with results made in the northern hemisphere. The results of old samples from the Akatarawa Stream show two small peaks in 1957-58, which correlate with radioactive fall-out peaks in the northern hemisphere and also with nuclear bomb explosions. The results from the geothermal waters are helping geothermal workers in their study of underground water circulation. A redetermination of the natural rate of production of tritium using data on the fall-out of natural tritium at a number of stations on the earth's surface has been made. The rate predicted is equal to that predicted from the inventory of tritium present in the earth's atmosphere and in the oceans.

CARTOGRAPHY

Cartography as a medium of recording and publishing results of research in the fields of geology, oceanography, and geophysics is playing an increasingly important role in the work of the D.S.I.R. The accelerated programme of mapping by the New Zealand Geological Survey, the development of a work programme by the New Zealand Oceanographic Institute, and the increasing research work of the Geophysics Division have resulted in a notable increase in the number of maps demanding the attention of the Chief Cartographer and his staff. The increasing availability of such maps has brought in its train

an increasing demand from university scientists, teachers, and Government departments. The New Zealand Geological Survey aims to have available by 1964 complete geological coverage of New Zealand; the New Zealand Oceanographic Institute is formulating the results of its research, calling for maps and charts to record the investigations concerning ocean bottom and waters surrounding New Zealand; the Geophysics Division contributes an increasing flow of magnetic, gravity, and other maps recording physical measurements of the earth's crust.

During the past year 602 small maps, diagrams, and cross sections have been drawn to illustrate 148 scientific papers covering a wide field of scientific endeavour. These diagrams serve to illustrate papers in the *New Zealand Journal of Geology and Geophysics*, the *New Zealand Journal of Science*, the *Transactions of the Royal Society of New Zealand*, and several overseas scientific periodicals. During the same period coloured geological maps of Christchurch, and Fiord sheets of the 1: 250,000 series, and the Waiotapu sheet of the 1: 63,360 series, were completed and published. There are four maps of the 1: 250,000 series with the cartographic office approaching publication. In addition, four maps of the 1: 63,360 series for the Te Aute Subdivision, Hawke's Bay, are in preparation, together with detailed maps of the Ohai coal-field, Southland. For the New Zealand Oceanographic Institute charts illustrating the bathymetry of New Zealand, in particular the areas of Cook Strait, Palliser, Mahia, and Cape Campbell, are in an advanced state of preparation. Investigations into the Waiotapu geothermal area have required the preparation of maps to illustrate many geophysical measurements made in that area.

In order to deal with this increased flow of work the draughting staff has been increased since 1957 and what is virtually a Cartographic Division of the D.S.I.R., with headquarters at the New Zealand Geological Survey, is forming.

Very close liaison exists between the D.S.I.R. cartographic section and the cartographic section of the Department of Lands and Survey with the result that the 1: 250,000 mapping project is a joint one—topographic bases are being drawn for this project in both institutions.

Considerable attention has also been paid to modern map-preparation techniques and procedures in cartography. This is done by the representative of the Department on the Map and Chart Reproduction Committee which was constituted to consider ways and means of improving the quality of maps and the speed of their production. This committee has close relations with similar committees in both the United Kingdom and the United States. Through this close liaison it is able to obtain the very latest information and views from mapping agencies in both these countries, with the result that cartographic work in New Zealand is able to match the considerable progress that is being made overseas, both in methods and materials. Much of the information gleaned through these channels has been adapted by the New Zealand cartographic agencies with considerable benefit to the standard of maps produced in this country.

GEOLOGICAL AND TOPOGRAPHICAL MAPPING OF THE ROSS DEPENDENCY

A major activity of the Antarctic programme, of the Antarctic Division, has been the continuation of the geological and topographical surveys of the Ross Dependency begun by parties from the trans-Antarctic Expedition. In February 1957 Gunn, Warren, and Heine made the first geological survey of the Skelton Glacier region. In the 1957-58 season Brooke's party worked in the region of the five glaciers debouching into the Ross Sea between 76° and 78° South; Ayres and Carlyon in the Britannia Range, and Miller and Marsh in the area bounded by Shackleton Inlet, the Ross Ice Shelf, the Marshall mountains, and the unmapped region to the west. During the same period the Geological Survey's team of eight led by Harrington worked from Hallett Station northwards in Moubray Bay and west up the Tucker Glacier into the Admiralty Range.

In 1958-59 the projected geological and survey expedition in the Wood Bay and Terra Nova Bay areas was frustrated by ice conditions and the party of 12 worked the whole summer in the McMurdo Sound region. Considerable biological work was also carried out on Coulman Island and on the islands further south. Mounts Erebus, Terror, and Discovery were among many peaks scaled, the last two being first ascents.

These expeditions surveyed some 44,000 square miles of the Ross Dependency; the Department of Lands and Survey is publishing maps of the area covered. A map of the Hallett region is in the press, and concurrently the geological findings are being written up and published by the Geological Survey. In this work assistance is being provided to the United States by the establishment of some 34 ground control points, the greater portion of them by Harrington's 1958-59 party. These control stations are a very necessary part of the overall United States plan for the aerial mapping of these areas. All data obtained are supplied to the United States authorities. In extension of this work it is proposed to continue geological and topographical work until the Ross Dependency is completely mapped.

The plan for 1959-60 involved the use of two sno-cats, purchased from the trans-Antarctic Expedition, as well as dog teams to explore the coastal area between Barne Inlet and Shackleton Inlet. The dog teams were then to carry out a reconnaissance of the area south to the Beardmore Glacier preparatory to a fuller investigation of this area in 1960-61.

These plans were disrupted by the crash of one sno-cat into a crevasse near Cape Selborne, resulting in the death of Lieutenant T. Couzens and serious injury to the party's two geologists, Gunn and Lowery. At the time of the accident they were making for rock outcrops sighted west of their camp, in order to carry out geological work.

With United States Air support the dog teams and all six available men were transported south, and the party began the geological and topographical survey of the area between the Nimrod and Beardmore glaciers. A camp was set up at 3,500 ft and a station carried to 6,000 ft. During this period the New Zealand Beaver aircraft was wrecked and the party was flown out to Scott Base by American aircraft. Despite these severe setbacks, approximately a further 3,000 square miles has

been surveyed and over 20 ground control stations established. A unique series of rock and fossil collections from the Beardmore region was obtained and these are now being studied. Glaciological studies were also carried out on the Ross Ice Shelf.

RESEARCH ON FOSSIL POLLEN AND PLANT MICROSPORES

For many years it has been known that many species of present-day plants have each a distinctive type of pollen or spore; pollen specialists can examine pollen microscopically and determine what plant species produced it.

For the past 12 years the New Zealand Geological Survey has been applying this knowledge to the study of fossil-pollen grains, extracted with strong acids and other chemicals from shale, mudstone, and other fine-grained, loosely compacted sedimentary rocks. (Successful extractions of pollen have been made from New Zealand rocks up to as much as 100 million years old.) In this way much has been learned about the types of plants that have flourished in New Zealand in the past, adding to the knowledge that had earlier been gained from the study of rarer fossil leaves and seeds.

The greatest value of fossil-pollen research to geology has been that it has helped to make it possible to determine the geological ages of sedimentary rocks that were formed on land ("non-marine" rocks as they are called). For determining the ages of marine sedimentary rocks, marine fossils such as shellfish and Foraminifera are normally used, but these are absent in non-marine strata. This technique has been of great economic value in New Zealand's coalfields where study of the fossil pollen in the coal-bearing rocks has enabled geologists to recognise the age and stratigraphic position of coal seams and correlate them from place to place. This has greatly helped the determination of the structure of the coalfields and the prediction of the position of hidden seams. It is interesting to record that the Geological Survey's pollen specialists recently prepared and examined pollen samples from coal obtained, at depths between approximately 10,000 and 13,000 ft, from Shell, B.P., and Todd Oil Services' exploration bore at Kapuni, in Taranaki. In a report prepared for this oil company it was possible to give the approximate geological age of the coal and to comment on the climatic conditions that probably obtained during its deposition.

A major step forward in pollen research in New Zealand will be the publication this year of a *Geological Survey Paleontological Bulletin* which records the important results of a new phase of the work—the successful extraction of pollen from marine sedimentary rocks. The geological ages of the marine strata used were already closely known from the marine fossils they contained. This, therefore, provides an accurate guide to the age of the pollen. The stratigraphic ranges of pollen species can thus be determined much more closely. The bulletin will describe 139 species of fossil pollen and spores.

Another interesting aspect of pollen work is what it tells about past climatic conditions in this country. Particular attention has been paid to the pollen evidence concerning the several fluctuations of climate during the great Pleistocene Ice Age from which New Zealand, like much of the world, has only recently emerged. This work has been greatly aided

by the technique of radiocarbon dating employed by the Department's Institute of Nuclear Sciences. By this method the approximate age of suitable sedimentary rock deposits, up to a maximum of about 40,000 years, can be obtained by measuring the age of fossil wood or other carbonaceous material they contain. In a number of localities pollen from deposits, thought to have been formed during the Pleistocene, has proved to be that of types of plants typical of severer climatic conditions than obtain there today.

Particularly important to the field geologist, as an aid to interpretation of the history of erosion and deposition, is evidence from pollen samples collected recently from the Opunake-Stratford area of Taranaki. These samples show that around Mt. Egmont, 30,000 to 40,000 years ago, the timberline had retreated down to about present-day sea level. For this to have happened temperatures then were probably some 12° F or 13° F cooler; this was presumably the peak of the last glaciation of the Pleistocene, a time when glaciers were known to have been widespread in the mountains of the South Island. Evidence of similar subalpine conditions has been obtained around Wellington from fossil pollen, seeds, and leaves collected from deposits in the Hutt Valley, Porirua, and elsewhere.

This research on climatic fluctuations is only in its infancy. As pollen research, radiocarbon dating, and geological work progress, an increasingly clear picture of Pleistocene climatic changes will be built up. This knowledge will be of the greatest interest to New Zealand biologists interested in the history of our fauna and flora, to geologists and to oceanographers, and also to overseas scientists who look to New Zealand for information about the effects of the Pleistocene glaciations in the Southern Hemisphere.

SEDIMENTS ON NEW ZEALAND'S CONTINENTAL SHELF

A large number of samples, including numerous cores, have been taken by the New Zealand Oceanographic Institute in selected areas of the continental shelf around New Zealand. The areas where concentrated sampling has been carried out are Hawke Bay, Cook Strait, and west of the North Island from Kaipara to Wanganui. Results show clearly the importance of wave action and tidal current in determining the pattern of sedimentation on the shelf. Since the stirring action of waves on the bottom sediment becomes progressively less with increasing depth, it would be expected that any shelf sediment distributed principally by waves would show a progressive decrease in grain size away from the coast. This state of affairs is actually found near the coast in Hawke Bay and west of the North Island; in both areas a sandy belt near the coast gives way to mud further out, the transition zone being in about 10-20 fathoms in Hawke Bay and in 40-50 fathoms on the west coast. In Cook Strait, the same effect is seen on a more limited scale, but here distribution of sediment is dominated by strong tidal currents, particularly in the narrowest part of the Strait. The central part of the Strait is floored by shingle, gravel, and sand, which were not deposited under present-day conditions, but belong to a period of lower sea level. These coarse sediments lie for the most part in depths of more than 50 fathoms, but the tidal stream prevents any fine sand and mud from settling and covering the older sediments.

The outward transition from coarse to fine sediment which occurs in Hawke Bay does not persist without interruption, for there is a sizable patch of fine gravel and sand on the central part of the shelf, this being separated from the sand belt near the coast by a zone of mud. The gravel and sand was obviously deposited when sea level was lower than at present and its freedom from more recent sediment may well be due to a gentle tidal stream flowing over the central shelf and preventing fine sediment from settling in that part of the area.

These studies have a fundamental importance in assessing the significance of sediment types in rocks ashore. The sampling from the west coast of the North Island has permitted an analysis of the amount of ironsand located in the surface sediments on the shelf.

NEW ZEALAND BENTHIC SURVEY

The distribution and abundance of fish are controlled by several factors. Temperature, salinity, water currents, and available food are a few of the more obvious. These factors tend to be closely related; thus, the presence of certain types of food may be connected with the temperature of the surrounding water, which in turn may be affected by the tidal stream which distributes the eggs and young of the fish—but perhaps the most important single factor is the quantity and kind of food available.

Many of our most important fish are bottom feeders—snapper, flounder, and blue cod for example—and their food preferences are varied. They may prefer shellfish to crabs, or crabs to worms, or they may like a varied diet, or more commonly they will change their diet throughout the year according to the type of food most abundant, or even perhaps to suit their individual tastes.

Thus, any study of the distribution and abundance of bottom-feeding fish must at some stage inevitably come back to a study of the distribution and abundance of their food—the worms, crabs, shellfish, starfish, sea eggs, and all the many other small animals which live in the muds and sands of the sea bottom. These are known to the biologist as the *benthos*, and the New Zealand benthic fauna is the object of a survey at present in progress on the continental shelf by the New Zealand Oceanographic Institute.

Samples taken by grab, dredge, trawl, and underwater camera reveal the types of animals present and give some indication of their abundance and availability. At the same time, samples of the sediments in which they live are also taken, not only for studies on sedimentation—where it came from, how it got there, what is happening to it—but also to discover what effect the type of bottom has on the quantity and kind of benthos present.

Some of these animals, furthermore, are themselves of present or potential interest and economic value. Apart from toheroas and pipis, others such as scallops, shrimps, clams, prawns, and even sea eggs are not without their appeal to the connoisseur of sea foods.

In the past year, the survey has concentrated on the west coast of the North Island and the western approaches to Cook Strait. In previous years concentrated sampling has been carried out in Hawke Bay, Milford, and Cook Strait, and this year work is planned for Foveaux Strait.

Intensive benthic sampling around New Zealand has another important aim. Most of our marine-bottom fauna is still inadequately known. The survey in progress is enabling the building up of collections from which specialists are able to identify and describe the common New Zealand species and a goodly proportion of the rarer ones. This is a necessary preliminary to any fundamental work on the distribution and abundance of fish food and, by inference, of fish themselves.

HIGH SPEED PARTICLE COUNTER

The counting of small particles is frequently carried out by distributing a sample on a microscope slide and counting by visual examination, a slow and fatiguing process.

Equipment has been developed by the Auckland Industrial Development Laboratories, to perform a counting sequence automatically. The particle is held in suspension in a liquid and drawn through a capillary fixed to the stage of a low-power microscope. An image of the capillary is formed at the eyepiece directly on to a photo-transistor and a compact transistor amplifier built on the eyepiece supplies an electrical impulse when the shadow of a particle crosses the field. These impulses are suitable for counting by commercially-available electronic counters. The unit is compact and rugged. It is being used for apple cell counting at the Fruit Research Division; a second model is to be used at the Plant Chemistry Division for counting protozoa. A future development may include facilities for sizing the particles.

UTILISATION OF NEW ZEALAND EXOTIC TIMBERS

In the utilisation of New Zealand exotic timbers, principally radiata pine, the major defect to overcome has been the presence of knots. Modern methods of rejoining and gluing are becoming firmly established here and the Auckland Industrial Development Laboratories have held three symposia in recent years on relevant details. A large factory for wood-laminated products has recently gone into production and finger-jointed flooring and mouldings are also now available. Practical work by A.I.D.L. in this field has included the testing of various timber-adhesive combinations and joints, as required by industry and architects, full scale tests on a set of beams fabricated with corrugated plywood webs and laminated radiata chords, as well as bend and penetration tests on finger-jointed floor panels. These latter tests have resulted in State Advances Corporation approval of finger-jointed flooring for residential purposes. A summary of the existing state of knowledge of the compatibility of synthetic resin adhesives and timber preservatives has also been prepared and distributed.

METALLURGICAL PROBLEMS

The metal working and engineering industries occupy a fundamental place in the expansion of manufacturing industry.

This fact has given impetus to the metallurgical work of the Auckland Industrial Development Laboratories and the experimental foundry which was set up to deal with manufacturers' problems is now fully in operation. Equipment includes a cupola furnace, electric and fuel-fired melting furnaces, and sand-moulding equipment.

As gun-metal ingots used in this country are made from secondary metal scrap, the degree of contamination is likely to be higher than is usual overseas. A preliminary investigation has been completed on the effect of impurities on casting qualities and mechanical properties, but further work may be desirable in the light of the results of a somewhat similar investigation at present being made by the British Non-Ferrous Research Association.

Iron foundries which find difficulty in producing castings of guaranteed quality are being assisted by work designed to show how specified mechanical properties in castings of various sizes can be achieved by additions of steel scrap or alloying elements to the cupola charge or to the ladle.

In addition to the foundry investigations, a number of other metallurgical problems have been studied in cooperation with manufacturers. One of these concerns the local production of automobile springs. Inspection of initial batches of these resulted in a high proportion of rejects, but following an examination of the principal defects and the fixing of reasonable dimensional tolerances and standards of quality, considerable improvement has been achieved and the reject rate is now very low.

GAS-PRESSURE ALARM SYSTEMS IN TELEPHONE CABLES

Trunk telephone cables are usually buried underground and are protected from the moist, corrosive, and conducting environment by a lead sheath. Faults develop in this piping due to earthquakes, electrolytic action, corrosion, and on occasion, the misdirected stroke of a pick; but these leaks do not necessarily lead to an immediate breakdown in communication. It is, however, desirable to detect the leaks before moisture diffuses in, causes such a breakdown, and possibly damages a section of the cable as well.

A detection system of the following design is at present being used in many countries and will be used on certain main-trunk cables in New Zealand. The space between the conductors and the sheath is charged with a gas under a moderate pressure and an alarm system is triggered by any one of a set of pressure detectors spaced along the cable which happen to register a certain predetermined pressure drop. When such a cable is punctured, the gas pressure at each point in the cable gradually falls, falling faster near the site of the puncture and eventually triggers the alarm system at the nearest detector to the leak. Such a system not only warns of a leak but also gives a rough indication of its position along the cable. More information on its location can be obtained by sampling the gas pressure at closer intervals in the neighbourhood of the triggered alarm.

The possibility arises of being able to design an alarm system which will give some indication of the size of a fault as well as its location. There are obvious advantages in having such a system, not the least of which is that it would be unnecessary to send men out at an awkward hour to mend a puncture which could be safely left till the next day. Before this can be done the designer must have a detailed knowledge of the rate at which pressure is lost at the site of a puncture in terms of its size, and of the shape of the pressure drop wave which travels along the cable as gas escapes through the leak.

The Applied Mathematics Laboratory found that the properties of this pressure wave were determined by a differential equation which equated the amount of gas lost from any section of the cable per second to the flux of gas through the ends of the section; this flux being determined by the pressure gradient at the respective sections. The final result of this research was a method of calculating the required shapes of these pressure waves for a cable of given permeability to the gas, for any size of puncture—thus laying the foundation for a sound approach to the designing of these cables.

WOOD PRESERVATION—LOADING AND PENETRATION OF WOOD PRESERVATIVE

The susceptibility of pine, larch, and douglas fir timber to decay when exposed to severe decay hazards frequently justifies impregnation with suitable preservatives before use. In the Rueping process such preservatives are forced into the timber under controlled conditions of pressure and temperature. The loading or amount of preservative contained in the timber, and the depth of penetration must be maintained at specified levels to ensure a satisfactory treatment. The preservative treatment of suitable forest produce, mainly in diameter sizes too small for sawlogs, enables otherwise waste forest produce to be utilised as fence posts for farms, and poles for telegraph, power, and other uses.

Some species having desirable qualities in other respects are difficult to impregnate to the economic standard. An investigation was made by the Applied Mathematics Laboratory in collaboration with the New Zealand Forest Service, and a formula was obtained showing how the depth of penetration of preservative varied with the time of treatment, pressure applied, viscosity and temperature of preservative, and pore size of the timber. The relative importance of these factors was thus determined, allowing a greater degree of control of the process. It was shown that the size of the channels or pores in the timber may be critical in so far as pores below a certain size would admit little or no preservative under normal operating conditions of temperature and pressure. Results of trials carried out by the New Zealand Forest Service at Waipa Mill supported the conclusions expected from theoretical considerations and a fuller understanding of the mechanism of absorption has been established.

In 1954 similar work was carried out by this laboratory for Plant Diseases Division on their investigation of the boron momentary dip diffusion process, and since its adoption as a method of timber treatment the problem of treating plants producing timber meeting specification has arisen. At present a sampling scheme is being designed for the New Zealand Forest Service to enable a statistical estimate of the percentage of timber failing to meet specification to be obtained. This will result in a more satisfactory control of plant performance and ensure that the required standard is maintained without unnecessary and costly timber sampling.

CELL WALL GROWTH

Although a very great deal is known about the effect of growth substances on plant growth, the detailed manner in which the cell wall actually increases in area is not, at present, well understood. It is the

aim of this investigation at the Dominion Physical Laboratory to see if further light can be shed on the nature of the process. The internodal cell of the alga *Nitella* is being used because, for various technical reasons, it proves to be a very satisfactory material.

A complete understanding of the process of extension growth requires a knowledge of the submicroscopic structure of the cell wall and various physical techniques are being used to determine the structure in some detail. An encouraging start has been made in relating the observed mechanical properties of the cell wall to its fine structure. The results appear to be consistent with the idea, advanced by earlier workers, that extension growth is due to a disturbance of molecular forces within the wall causing its physical properties to be changed in such a way that it is stretched by turgor pressure. More work remains to be done, however, before any general conclusions can be drawn.

It is hoped that the experience gained in relating mechanical properties to structure will prove useful in shedding light on other biological problems.

Part of this work was carried out in the laboratories of Professor R. D. Preston, F.R.S., at the University of Leeds and is being continued at the Dominion Physical Laboratory.

FACIAL ECZEMA RESEARCH

In a recent publication by Dr M. B. Ellis of the Commonwealth Mycological Institute, the name *Sporidesmium bakeri* Syd. is shown to be synonymous with *Pithomyces chartarum* (Berk. & Curt.), M. B. Ellis, which now becomes the accepted name.

At the Plant Diseases Division isolants from pasture litter samples collected during the 1959 season from facial eczema areas yielded a high percentage of low sporing strains with a relatively low production of toxin. Out of more than 200 isolants only two showed a toxicity comparable with that of the original strain isolated by Dr Thornton. Studies with these isolants involving determination of cultural characters, morphology, growth rate, temperature relationships, and toxicity indicate that there are a number of strains of *P. chartarum* in New Zealand. Initially evaluation of toxin production was greatly handicapped by difficulties involved in the guinea-pig test, but since workers at Ruakura Animal Research Station have isolated the toxin and developed methods for its estimation by paper chromatography, the assessment of toxin in spores from different strains has been reduced to a routine laboratory test.

The isolation of so few high-sporing toxic strains during the 1959 season suggested that the sampling method may have been too selective. Therefore, during the present season, agar plates are being exposed throughout the North Island in pastures where facial eczema has been known to occur, and cultures prepared from germinating spores of *P. chartarum* which have settled on the plates. Results so far obtained indicate that this is a more satisfactory method of estimating the type of fungus population present in a pasture; they also suggest that the high sporing strains are associated with pastures in which incidence of the fungus is high.

With the discovery that laboratory cultures of the fungus *Pithomyces chartarum* could produce lesions in the livers of guinea pigs and sheep which were characteristic of facial eczema, it was necessary to determine the role of the fungus in the naturally occurring disease in the field. Studies on the distribution of the fungus were therefore undertaken by the Soil Bureau in collaboration with Manutuke Research Station of the Department of Agriculture. The fungus was found to grow particularly vigorously on freshly damaged or killed plant material and also on the cut edges of growing grass. The numbers of spores were counted by a dilution technique and were found to vary considerably with pasture management. Within the summer-autumn period it appeared that microclimatic conditions in pastures were of great importance.

In the field, it is likely that sheep ingest much of the toxin from spores blown on to the leaves of pasture plants by wind or by stock disturbance. Measurements have shown that the air-dry densities of spores are comparable with those of pollens which are known to be blown over long distances. At Manutuke, lambs developed clinical symptoms of facial eczema and showed severe characteristic liver damage when spore counts were above a certain level. On pastures with spore counts below this level only a few cases of mild liver damage were recorded. These results indicated a correlation between the numbers of spores and the occurrence of the disease in sheep and suggested that a certain number of freshly produced spores were necessary for the development of toxicity. It should be pointed out that high numbers of spores need not necessarily indicate that a field is toxic as it would appear that the toxin content of some spores is very low. Further detailed studies of the occurrence and toxicity of the fungus in the field are necessary to completely clarify its role in the disease of sheep and to assess practical possibilities of predicting outbreaks of facial eczema from the determination of spore counts. These aspects are now being investigated at many different centres of the Departments of Agriculture and Scientific and Industrial Research.

In the Soil Bureau laboratory, pure spores and cultures of *P. chartarum* on vegetable extract media have been grown and prepared at the request of other research organisations. Studies have been made of the growth of the fungus on various synthetic media and of the influence of different factors on the production of spores. The addition of some organic nitrogen compounds was found greatly to encourage sporulation, and a synthetic medium has been developed which gives high yields of fungal material, spores, and toxin. This medium could be of considerable use for studying the metabolic characteristics of the fungus and might also be suitable for large-scale production of toxin.

The effect of growth conditions on toxin production is being studied by the Soil Bureau in collaboration with Wallaceville Animal Research Station, using guinea pigs and sheep as assay animals. The spores of this fungus are highly toxic but their presence is not essential for toxin production as toxin has been formed in the usual amounts by a strain which produces only a low number of spores. A strain of *P. chartarum* isolated from air in Kansas, U.S.A., was kindly provided by Dr S. J. Hughes and was found to be toxic when grown under our laboratory conditions. It is therefore clear that the New Zealand strains of this

fungus are not peculiar in their ability to produce toxin and it would seem probable that facial eczema could be expected in other countries under suitable conditions of pastures and climate. It is of interest to note that outbreaks of facial eczema have recently been reported from Victoria, Australia.

Anti-fungal Substance—Comparative studies have been undertaken at Grasslands Division on the growth of *P. chartarum* on leaves, expressed juices, and extracts of common pasture plants. Results from these studies indicated that substances with fungi-toxic properties are present in some species, notably in sweet vernal and red clover.

During the past year a systematic investigation of these anti-fungal substances was carried out at Plant Chemistry Division. The active principle in sweet vernal was shown to be coumarin, a known constituent of this and other plants. It is a volatile solid with a pleasant odour and a bitter taste and has pharmacological effects on higher animals.

The anti-fungal principle in red clover has also been identified and a small quantity of the active substance has been isolated. The chemical structure of this substance has now been found to be that of a new compound belonging to a rare class of natural products. Chemically it is closely related to the oestrogenic substance biochanin-A and both are inter-convertible by oxidation and reduction reactions. There is good evidence that the anti-fungal substance is convertible to biochanin-A during the processes of isolation and concentration, which makes it difficult to isolate this substance. The functions of this and other biologically-active products in red clover are not known, but it is possible that the anti-fungal substance may play a part in the natural disease resistance of the plant. Further anti-biotic tests are planned to assess the potency of this substance against *P. chartarum* and other micro-organisms.

Lipids of P. chartarum and Related Fungi—As part of the collaborative investigations on *P. chartarum*, the fatty acid composition of this and related species has been determined by the Fats Research Laboratory. Using a fat-free culture medium it was found that *P. chartarum*, the related *Stemphylium dendriticum*, and the unrelated *Cylindrocarpon radicum* yielded 4.5 per cent, 2.4 per cent and 7.5 per cent lipids respectively. In the first two species the lipids were distinguished by their high contents of linoleic acid (40–60 mols per cent) together with substantial amounts of palmitic acid (18–30 mols per cent). *C. radicum* lipids on the other hand had lower amounts of linoleic acid. These results suggest that the composition of the endogenous fat might be useful as an aid to the classification of fungi.

In order to ensure coordination of all research work proceeding on facial eczema research, regular meetings of the research workers concerned are being held.

ANIMAL TREADING

A major characteristic of New Zealand pastoral farming is its high production level, and the fact that our animals are wintered outdoors. This has great advantages in lowered feeding and conservation costs, but

its effects on the pasture are not clearly understood. At Grasslands Division, work is under way to obtain a clearer interpretation of animal treading effects, not only under different soil and climatic conditions but also the reactions of the several pasture species in general use.

Using a field technique based on how far animals travel each day and using sheep in measured races and for specific treading times, some valuable data have already been secured. The overall effect of treading on mixed swards in short-term trials is to depress yields, with particular damage in extremes of both dry and wet. There is however a marked difference in species recovery from treading damage; ryegrass, white clover, timothy, and *Poa pratensis* all recover well, but cocksfoot, Yorkshire fog, red clover, browntop, and *Poa trivialis* are easily damaged. Such differential effects are giving a much better understanding of the pasture management practices and also more purpose in devising pasture mixtures. For example, the development of the ryegrass, white clover pasture, under high fertility and high winter carrying, is obviously due to this treading factor. By contract, unless such pastures are in fact adequately winter stocked, species such as *Poa trivialis* or Yorkshire fog will invade, with lowered production in the following season.

In addition the work draws added attention to the need for single plant studies for plant breeding and selection to be conducted under actual or simulated treading, as well as under grazing and manuring.

These treading studies are being extended to study the effect of soil type, moisture status, interval between grazings, herbage cover, and the plant characters involved in resistance to or recovery from treading by different types of stock.

PASTURE ESTABLISHMENT IN NORTH AUCKLAND

A significant part of the development programme at the Kaikohe substation of Grasslands Division has been directed at the typical heavy clay "gumland" (Wharekohe soil type) which in its initial state is very acid, extremely low in plant foods, and with a typical "gumland" cover of stunted manuka and rushes. The standard breaking-in procedure of crushing, burning, and discing in summer was followed, and pastures were sown after a fallow of approximately 15 months.

Spectacular results have followed the use of heavy dressings of lime, phosphate, and potash at time of sowing. With this treatment a lower than normal seeding of ryegrasses proved advantageous in facilitating early development of clovers. Pasture establishment was excellent on the heavily manured areas and grazing was commenced in early August. By the following summer the heavy fertiliser treatments were carrying 10 to 12 wethers per acre. Further similar trials have shown that the normal carrying capacity of about two ewes per acre on this soil can be raised to at least eight, and the resultant pastures, now two years old, have remained free of manuka and rushes, two weeds often troublesome on this soil type.

These results have stimulated much local interest. Trials are now being laid down to assess more accurately the minimum rates of fertiliser application necessary for good pasture establishment and continued high production. On this soil type, surface drainage is important and more

information is needed on weed invasion under high stocking rates. The effect of heavy liming on the availability of copper and boron in these soils also needs study.

The initial results obtained and the high carrying capacities achieved show promise of greatly increasing the farming potential of North Auckland.

BIOLOGICALLY ACTIVE SUBSTANCES IN RED CLOVER

Oestrogens—Oestrogens are substances capable of producing changes in the reproductive organs of animals similar to those occurring during oestrus in the normal animal. Oestrogenic substances in plants have assumed considerable importance since the demonstration of their presence in clovers and the suggestion of their possible beneficial effects on milk and meat production when present in small amounts, and of their responsibility for infertility in sheep grazing on certain types of clover-dominant pastures. Included among the pasture plants from which oestrogens have been isolated by overseas workers are subterranean clover, red clover, and the ladino strain of white clover (*Trifolium repens*).

Subterranean clover-dominant pastures in Australia have resulted in large economic losses through the infertility of sheep grazed on them. Investigations in Australia have shown that subterranean clover contains genistein, one of a group of substances known as *isoflavones*. These substances are chemically very different from natural oestrogens of animal origin. Genistein was found to be only weakly oestrogenic (activity approximately one hundred thousandth that of the natural steroid oestrogens) but was present at a high enough level to have pathological effects on grazing animals. Extracts of British pasture plants, in particular red clover, have also been found to be oestrogenic. The substance biochanin-A, closely related to genistein, has been isolated from English broad red clover and was found to have oestrogenic activity about equal to that of genistein. Subsequent work has shown that both genistein and biochanin-A are present in both red and subterranean clovers. A third substance of closely related structure, formononetin, was also present in both species but was found to be inactive in test animals at relatively high dosages. More recently a new oestrogen, coumestrol, a derivative of coumarin and with an activity 30–40 times that of the *isoflavones*, has been isolated by American workers from ladino clover. Coumestrol is reported to be present also in other pasture species, notably red clover.

Isolated incidences of breeding disorders in sheep grazing on red clover-dominant pastures have been reported in the past in New Zealand. Recently, biological tests carried out at Massey College have shown that the local strains of red clover are oestrogenic. Chemical studies at Plant Chemistry Division have shown the presence of the oestrogens genistein and biochanin-A in all strains of local red clover, with formononetin also present in relatively large quantities. Preliminary evidence indicates that other *isoflavones* are also present in red clover as minor constituents and it is possible that some of these closely related substances may also have oestrogenic activity. Contrary to American

reports no coumestrol was detectable. As yet no convenient chemical method is available for the quantitative estimation of the known oestrogens in red clover but there is some indication that contents of these substances, which are found only in the leaves, vary with season.

TUSSOCK GRASSLANDS

The extensive tussock grasslands of New Zealand play an increasingly important role in pastoral production, water conservation, and flood protection. Their continued use and intelligent future development rests to a great extent on the fullest understanding of their botanical structure, as well as study of the environmental factors influencing them. For a long time there has been the general broad classification into low-tussock grassland, tall-tussock grassland, and red-tussock grassland. While this still holds good, there is a demand for more precise information, so that a more accurate subdivision of the broad groups can be made, and a better understanding obtained of their relation to present and past climates.

To satisfy these needs Botany Division has been studying the South Island tussock grasslands for some time. This has resulted in the discovery of two undescribed and widespread grassland associations, both of botanical and economic importance. One of them is important because it includes a palatable species in large quantities, the other, because of its relationship to protection forests east of the Main Divide. The botanical significance lies in the necessity to fit these into the overall classification of vegetation, and in the probability that other associations remain undiscovered and undescribed.

Above the beech forest in Canterbury an undescribed *Danthonia* sp. either alone or in association with *D. rigida* dominates a grassland in which *Celmisia lyallii*, or *C. spectabilis* (cotton plant) in some areas, is an important element.

In parts of South Canterbury, North and Central Otago, predominantly in the wetter western area though extending into the lower rainfall zones, *Festuca matthewsii* (Hack.) Cockayne, a blue erect tussock, is abundant in the snow-tussock (*Danthonia rigida* Raoul) grassland at mid and high altitudes. Here blue tussock (*Poa colensoi*) is also an important species. In some sites where snow tussock has been removed by burning, *F. matthewsii* often assumes local dominance. Matthew's fescue is grazed extensively in these areas and represents a useful natural resource.

This Matthew's fescue/snow-tussock association, contrasting as it does with that north of the Two Thumb Range - Hunters Hills system, where cotton plant (*Celmisia spectabilis*) is the most common associate of snow tussock, adds some precision to our knowledge of the community as a whole, and indicates more accurately the differences which must be considered in the plan for maintenance or development of these grasslands. Further work on this grassland is proposed to complete the study of its distribution and of the other aspects of its development. However, these studies are only one part of the fuller ecological study of the tussock grasslands of South Island which are necessary to prepare any new synthesis of these grasslands and to relate them to the vegetation of New Zealand.

APHIS RESISTANT RAPE

The varieties of rape grown in New Zealand are very susceptible to damage from aphids, and in many years these insects seriously reduce the effective yield of rape, particularly in the lower rainfall areas of the South Island.

Lines of rape resistant to attacks of these insects have been selected from crosses between susceptible rape and resistant swedes. In the annual report of 1958, a preliminary account of their performance was given and it was suggested that they would be distributed for sowing farmers' crops in 1960.

Trials by Crop Research Division have continued since then, and seed of one of these selections, named Aphis Resistant Rape, will be distributed this spring in those districts most liable to suffer from severe aphid attack. Sufficient seed to sow several thousand acres is available for distribution.

The salient advantage of this new variety is its ability to remain free from damaging attacks of aphids where present varieties may be severely damaged or completely destroyed. The use of this variety will increase the chance of having feed available for fattening lambs when it is needed.

In a series of trials conducted this year, none of which was attacked by aphids, the aphis resistant variety yielded about 10 per cent less fodder than broad leaf essex, the standard rape variety; in the 1957-58 season it yielded about 20 per cent more. Yields, then, are comparable with yields of broad leaf essex in the absence of aphid attack.

Lambs have eaten aphis resistant rape as readily as broad leaf essex. Two trials comparing the weight increase of lambs on aphis resistant and broad leaf essex were conducted this year. In one, there were no significant differences between the weight gained by lambs on the two varieties; in the other, the lambs gained significantly more weight on aphis resistant than on broad leaf essex.

The objective of breeding a rape variety resistant to aphids, and otherwise comparable in performance with our existing rapes, has been substantially realised in the aphis resistant variety, which should permit more efficient production of fat lambs.

NEW POTATO VARIETIES

The yield of potatoes in New Zealand is notoriously variable and for years there has been a search for varieties with strong growth so that they could withstand wind and drought and control weeds, and also with resistance to potato late blight. Two new high-yielding varieties bred by the Crop Research Division appear to meet these requirements.

"Tahi" is a selection from the cross between Sebago and Harford. It establishes quickly and well, and soon produces strong, tough foliage. It is resistant to blight, drought, second growth, hollow heart and brown fleck. The tubers are medium sized, round and flattish with shallow to medium shallow eyes. The skin is white and inclined to be tender when immature but firm if allowed to mature. The keeping and cooking qualities are good.

Tahi is late but produces a very heavy crop if allowed to mature. It may be too late for Otago and Southland but should be a good maincrop variety for the rest of New Zealand especially where blight or drought is a problem.

"Rua" is a selection from the cross Katahdin by Harford. It is slower to establish than Tahi but ultimately produces strong foliage. It has some drought resistance, and resistance to the common races of blight, to second growth, hollow heart, and brown fleck. The tubers are oval to round oval with shallow eyes, medium sized, and with a fairly tough white skin. The keeping quality is good and it is usually more floury than Tahi.

Rua is not quite as late as Tahi but may still be too late for southern provinces. The yield is high, somewhat less than Tahi under most conditions, but may be as high on heavy soils. Rua may be a safer variety to grow where there is a risk of soils being wet in the autumn.

It is expected that sufficient seed will be available for distribution to growers of group I certified seed for planting in spring 1960.

CONTROL OF POTATO VIRUS DISEASES

Virus diseases are one of the main enemies of the potato crop, so that the production of seed potatoes is confined to those areas where the incidence of virus is low. The most destructive viruses are spread by aphids, and so it has been assumed that the better areas are the ones where there are few of the aphids responsible. Weekly counts of aphids by the Crop Research Division, over two years, at three sites, Lincoln, Darfield, and Annat have confirmed this. At Annat, 1,100 ft above sea level, very few of the most important aphid, *Myzus persicae*, are present at any time. At Darfield (600 ft), there are slightly more but still not many, whereas at Lincoln (130 ft) numbers can be high.

In all areas the distribution of the aphids is similar. The numbers rise to a peak in mid November, fall to almost nil by mid to the end of December, remain virtually absent during January and early February, and then rise to a smaller peak during March. At Annat, the best seed producing area, the numbers of aphids are always low and even at the peak are insufficient to cause much spread. By the time the peak numbers are present, any diseased plants can have been recognised and removed from the crop, thus reducing the possibility of virus spread. On the other hand, at Lincoln, even before the peak, the numbers of aphids are high, so that there can have been considerable virus spread before diseased plants are large enough to allow symptoms to be recognised and the plants removed. This is why at Lincoln it has never been possible to maintain healthy stocks by roguing out diseased plants, because further spread had occurred before roguing took place.

The introduction of systemic insecticides has opened up possibilities of producing better seed in such areas as Lincoln, where aphid numbers are high for only short periods. If the aphid populations can be kept to low levels until after the crop is rogued, it should be possible to prevent most virus spread. This can be done by spraying as soon as the crop is through, and then after two to three weeks, preventing the spring peak from developing. If roguing is delayed, a third spraying may be necessary. Once the spring peak is passed there is little danger of spread, for the autumn peak is usually too late to allow virus infection of the leaves to reach the tubers before harvest.

In areas that do not have the summer depression in aphid numbers, control would need to be extended over longer periods, but in Canterbury, two to three sprays plus roguing could effect a considerable improvement in seed health in marginal areas at an economic cost.

NEW HOP VARIETIES

Two varieties of hops, First Choice and Calycross, bred at the Hop Research Station for resistance to root rot (*Phytophthora* sp.) will be released to hop growers before the beginning of next season.

First Choice is an early variety of good yield, high dry-matter percentage and very high alpha-resin content. Calycross is a mid-season variety of good yield, high dry-matter percentage and high alpha-resin content. A third, late-ripening variety, Smooth Cone, will probably be released next year.

These new varieties are resistant to root rot, a disease which severely reduces the yield from the susceptible Californian variety now grown and which, in many gardens, necessitates the replacement of a high percentage of diseased plants annually. The new varieties are all higher in quality than the Californian variety and range in ripening time from early to late. Their use should enable growers to grow good crops on soils where root rot is now a serious problem, to produce a higher quality product and to spread the picking season.

OCCURRENCE OF PEA LEAF ROLL VIRUS IN NEW ZEALAND

A serious aphid-transmitted virus disease of legumes has been found to be widespread and to cause considerable economic loss in New Zealand. It has been identified at the Plant Diseases Division as pea leaf roll, a virus disease previously recorded only from Europe. Trials with the main New Zealand pea varieties and a collection of 62 varieties introduced from overseas, broadly confirmed the results of workers in Holland and showed that many varieties were highly resistant or tolerant to the virus. The varieties Greenfeast (Lincoln), Massey (Kelvedon Wonder), and Victory Freezer were in the resistant group, while Onward and Dark Skinned Perfection fell within the susceptible group. Experimental results were confirmed by observations in the field where early counts showed an incidence of 1 to 5 per cent for Greenfeast, Massey Marathon, and Victory Freezer, whereas Onward showed about 10 per cent and the field pea Blue Prussian about 30 per cent infection.

Tests on the 62 overseas varieties showed that 40 per cent of them were very tolerant to the virus, i.e., suffered less than 20 per cent reduction in yield, and that there were ample sources of resistance for the plant breeders to draw on.

Surveys showed incidence of pea leaf roll to be very high in broad beans, up to 100 per cent infection occurring in crops at Christchurch and Hastings. The disease appeared to be causing severe reductions in yield of pods owing to poor setting and increased attack by fungous diseases such as chocolate spot.

RETENTION OF VIABILITY OF NODULE BACTERIA (RHIZOBIA) ON
LEGUME SEEDS

The inoculation of lucerne seed, before sowing, with cultures of nodule bacteria is essential for successful establishment and promotion of good growth of plants, and has been standard practice in New Zealand for over 30 years. Work at the Plant Diseases Division has shown that under certain conditions, especially in virgin and second class country, inoculation with rhizobia also gives spectacular improvement in establishment and growth of clovers. Although some farmers are now inoculating their clover seed the procedure has not come into universal use. The reason is that the nodule bacteria when applied to the seed by normal inoculation procedures have a comparatively short life on the seed; yet, to be effective, they must still be present in large numbers when the seed germinates. It is common practice for pasture seed mixtures to be prepared by the merchants, and, even if clover seed is inoculated immediately before mixing, delays frequently result in death of bacteria before the seed is sown. Also, if conditions following sowing are not suitable for germination, death of the rhizobia may lead to poor results. Further, difficulties are experienced when aerial sowing is practised because exposure of seed to light and weathering causes rapid death of nodule bacteria.

Attempts have therefore been made at the Division to develop a method to prolong the life of the bacteria on the seed. By the use of certain stickers and cultures with a high bacterial count it has been shown that nodule bacteria can be held on the seed in a viable condition for at least four weeks. As a result of these findings high-count legume cultures and the special sticker are now available to all farmers from seed merchants.

Further work has shown that length of life of rhizobia on the seed can be extended to two months by the use of a pelleting technique. This work is still in progress and it is hoped that by improvement in the pelleting technique it will be possible to retain the viability of rhizobia on the seed for a period of three months. If this can be achieved inoculated clover seed could be sown with success in all areas in New Zealand by all existing methods of sowing including aerial sowing. Under these conditions inoculation of clover seed should soon become normal farming practice with consequent improvement in establishment of clovers in virgin and second-class country. This would lead to greatly improved pastures and a rapid increase in production.

BLACK BEETLE

The black beetle *Heteronychus sanctae-helenae* Blanch., which was first recorded in New Zealand in 1937, has in recent years become an important pest of pastures. At present the beetle is confined mainly to coastal areas in the northern part of the North Island, and outbreaks of epidemic proportions have so far been sporadic. A study of the ecology of the beetle in pastures by the Entomology Division has enabled the status of this insect to be viewed with greater clarity than has been possible in the past. Seasonal history studies show that the beetle has only one generation per annum, and overwinters predominantly in the adult form. Natural dispersion of the insect occurs in the autumn. Both larvae and adults of the black beetle are directly responsible for damage

in pastures, in consequence, pasture deterioration is continuous. The insect favours *Paspalum dilatatum* Poir. as a host plant, and is usually more abundant in soils which are either light, friable, sandy, or of a peaty nature. The results of insecticidal trials demonstrated that satisfactory control of *H. sanctae-helenae* larvae in pastures can be secured with dieldrin at dosages as low as 4 oz of toxicant per acre.

SCALE INSECTS ON APPLE FRUITS

With expansion into certain European markets and the tightening up of quarantine regulations in others, the conditions of entry of our export apple fruit into them have become more exacting. In the Nelson and Blenheim fruit-growing districts there are in the main two species of scale insects concerned in this matter, viz, the San Jose scale (*Quadraspidiotus perniciosus* Comst.) and Parlatoria scale (*Parlatoria pittospori* Mask.) while very recently a third scale the Circular Black *Lindingaspis rossi* Mask. has been found on apple fruits at harvest. The San Jose scale has, of course, been known on apple trees in New Zealand for very many years and has always occasioned some concern over its appearance on fruit. However, in the last two years the Parlatoria scale has been the cause of the rejection of a great deal of fruit for export and it is the scale that is of the greatest importance in this regard in this area. The Entomology Division is cooperating with local staff of the Horticulture Division of the Department of Agriculture to solve this problem. Up to date, efforts have been largely concentrated on the Parlatoria scale and biological data such as the life and seasonal cycles and habits of the insects have been accumulated in order to provide some means of satisfactory control. The scale has a fairly wide range of host plants but it is particularly prevalent on *Pinus radiata* which forms almost all orchard shelter belts in the Blenheim area. In Nelson such shelter belts are not so common. It has not been possible by diligent searching to find the scale on the wood of orchard trees but in every case where trouble on the fruit is being experienced, well infested pine shelter belts are present. Our work indicates very strongly that these shelter belts are the cause of the trouble. Young scales are produced on such pine trees from November to March and are blown on to the fruit trees. At the moment, the possibility of eliminating infestation from the pines is being explored as it is confidently felt that such elimination will solve the problem. Endeavours are also being made to explore the possibilities of biological control, not on the fruit trees themselves, but on the alternate host reservoir surrounding the orchards. This, however, is a long-term project. An endeavour is also being made to reduce the San Jose alternate host reservoir by the same means.

ANTARCTIC SOILS

Two members of the Soil Bureau went to Antarctica to search for evidence of soil-forming processes. The only true soils found were very shallow rock skins under mosses and lichens. However, many features of the early stages of soil formation in cold dry climates were observed. Soluble salts such as sodium sulphate and sodium chloride formed surface efflorescences in hollows and under stones. In places, sand and stone particles just below the surface were cemented with lime for thicknesses varying from $\frac{1}{8}$ in. to 3 in. Other signs of chemical weathering were

varnishing and iron staining of rocks. Physical weathering is widespread, particularly rock splitting and wind abrasion, to give stony and sandy materials. On slopes where water can accumulate there is considerable movement of the surface materials during the thaw season. Flows occur on slopes as low as 1° and produce long tongues of debris. Few soil striations were seen but large polygons up to 40 ft diameter were common on bare ground of flat to moderate slopes. Depths to the frost table were measured in numerous sites and appear to be related to drainage. On well-drained sites the frost table is deep whereas on poorly-drained sites it is very shallow. Data were collected from which it is intended to compile a sketch map of soils of the Ross Dependency. The expedition enabled Soil Bureau to examine soil formation under minimal conditions and to extend their range of soil observations across New Zealand territories from tropical islands to Antarctica.

Microbiological examinations have been made of some soils and vegetation from the McMurdo Sound area collected by university parties in previous years. Streptomyces and spore forming bacteria were absent. Other bacterial groups, protozoa, algae, and yeasts, where present, were physiologically similar to those found in temperate climate soils. The only organism isolated which showed particular adaptation to cold was the predominant soil yeast which had a maximum growth temperature in the region of 15°C .

SINGLE FACTOR MAPS

A study of element availability in soils, as indicated by the element content of a grass, sweet vernal (*Anthoxanthum odoratum*), has been expressed in map form for the North and South Islands. The present series prepared by Soil Bureau includes maps for the elements copper, phosphorus, molybdenum, magnesium, cobalt, zinc, potassium, and sodium. These plant maps will be accompanied by soil maps showing the amount of the element in the topsoil. Comparison of soil map and plant map indicates whether low amounts of an element in this grass is related to a straight deficiency in the soil or to an unavailability factor. In the case of phosphorus the maps show that the youthfulness of a soil is more important in controlling the phosphorus content of the grass than the amount of phosphorus in the topsoil, whereas with copper the soils with high amounts usually have grass with high amounts. The soil maps also show where reserves in the soil are low. For instance, copper is low in podzols and most peats. The map of sodium in the grass illustrates the influence of wind-blown salt which in these narrow islands, rivals the quantity produced by mineral weathering. This map can also be extended to show the effects on plants of other elements in sea water such as chlorine and magnesium.

POTASSIUM STATUS OF NEW ZEALAND SOILS

In recent years an increasing number of New Zealand soils have been shown to respond to potash and there has been a spectacular increase in the tonnages of potash fertilisers imported – from 12,500 tons of muriate and sulphate in 1950 to 55,500 tons in 1958. This represents an appreciable increase in farm costs, and the Soil Bureau is currently studying some of the factors governing the need for potash topdressing on New Zealand soils.

The potassium status of soils is most commonly expressed by a "soil test" value, which is essentially a measure of the available potassium present, but this figure is valid only for the soil at the time of sampling and gives no information about the long-term situation. Neither is the total potassium content of the soil any indication of its capacity to supply potassium to plants. In a chemical method developed at Soil Bureau a value for long-term potassium-supplying power (termed the K_c value) is obtained, that appears to represent fairly well the rate at which the available potassium can be replenished from the mineral reserves of the soil as the former is used up by plant growth. In general, high K_c values are associated with the presence of an appreciable content of minerals of the illite (hydrous mica) type in the clay fraction. The particular advantage of the K_c value is that it is independent of the recent agricultural history of the soil, including fertiliser applications, and so can be used to predict the likelihood or otherwise of potash responses in the future, which cannot be done from the soil-test value alone.

Using the genetic classification, New Zealand soils can be placed in three main groups:

1. *Soils with high K_c values*, comprising mainly weakly to moderately weathered brown-grey, yellow-grey, and yellow-brown earths and associated recent or young alluvial soils, occurring in the drier eastern parts of the country. In these soils, the weathering of illitic minerals is sufficient to replenish the exchangeable (available) potassium as it is drawn upon by the crop. Potash responses are consequently rare and unless much greater demands are made on these soils, as for example under irrigation farming or by frequent removal of hay crops, these soils should not require potash in the foreseeable future.

2. *Soils with medium K_c values*, comprising moderately weathered and leached yellow-grey and yellow-brown earths occurring in areas generally wetter than those in Group 1. In these soils the proportion of illite in the clay has fallen, with formation of the potassium-depleted mineral clay vermiculite. These soils are on the borderline of deficiency, because the rate of replenishment of available potassium from mineral reserves is no longer sufficient to meet long-continued heavy demands, and potash responses are increasingly observed within this group.

3. *Soils with low to very low K_c values*, comprising practically all those soils derived from volcanic parent materials, namely, yellow-brown pumice soils, yellow-brown loams (from andesitic ash), brown granular loams and clays (from old andesitic ash and andesite), and red and brown loams (from basalt), together with the strongly weathered and strongly leached or podzolised yellow-brown earths, the yellow-brown sands and the organic soils. These soils are all characterised by the virtual absence of illitic clay minerals. In the soils from volcanic parent materials the clay minerals consist mainly of allophane and hydrous oxides of iron and aluminium in the younger soils and kaolinite and crystalline oxides in the older soils. The strongly weathered yellow-brown earths and similar soils on sedimentary parent materials contain mainly kaolinite and secondary silica in the clay fraction. Although the total potassium content of some of these soils—notable the yellow-brown pumice soils (1.5–2.5% K) and the yellow-brown loams (0.7–2.0%)—is relatively high, this potassium is in the form of feldspars and acidic

volcanic glasses which weather too slowly to meet plant needs. The more strongly weathered soils in this group, such as the red and brown loams and the more mature brown granular clays, however, are low even in total potassium ($0.2-0.5\%$ K), and K_e values are consequently very low indeed. In all soils of this group, with inadequate release of potassium from the mineral reserves of the soil, as indicated by low K_e values, potassium deficiency is a permanent condition, which can be alleviated, under conditions of intensive farming, only by regular and frequent applications of fertiliser potassium: because of the nature of the mineral colloids, no large reserve of potentially available potassium can be built up.

Many soils in New Zealand are derived from parent materials of rather mixed origin, notably volcanic ashes mixed with various materials of sedimentary origin. The clay-mineral assemblages of such soils are therefore likely to be rather complex and, even if they are adequately known, difficult to interpret from the point of view of potassium-supplying power. The K_e values on the other hand appear to reflect reasonably well the mixed parent material on the one hand and the potassium status on the other hand.

It has been remarked above that large reserves of potassium cannot be built up in soils lacking illitic clay minerals. This is in accord with field evidence that responses to potash topdressing of volcanic soils under pasture, as in Taranaki province, are generally very short lived. This result is due partly to the mineral nature of the soil, as already indicated, but also to the effects, firstly, of rapid uptake ("luxury consumption") of potassium by the pasture—a consequence of the very soluble nature of potash fertilisers—and secondly, of inefficient redistribution of this potassium by the grazing animal. The effect of the animal is to concentrate the potassium from the herbage into the "urine patches", at a very high rate of application (equivalent to about 10 cwt./ac. of muriate of potash) while the remainder of the area receives no potassium after the initial topdressing.

A pot experiment at Soil Bureau with a yellow-brown loam from Taranaki showed that the effects of a "normal" topdressing of 2 cwt. ac. of KCl had virtually disappeared after four months, while at the end of six months both soil and pasture were showing deficiency levels of potassium. Even a 4 cwt./ac. application was virtually spent after six months. Growth response to sheep or cow urine (at 8 cwt. ac. KCl equivalent, roughly corresponding to a "urine patch") was due mainly to its nitrogen content and the percentage of clover was decreased. Although the potassium content of the pasture remained high, the available potassium level in the soil at the end of six months had fallen to a near-deficiency level. Losses of potassium from the soil by leaching were small (about 15 lb./ac. of muriate equivalent for the six months, spring to autumn, of the experiment) calculated on the basis of the whole area of a pasture. They were negligible except under the urine and 8 cwt./ac. KCl treatments, and almost all occurred within three months of application. In the winter months, with restricted growth of pasture, much higher losses by leaching could be expected. Since a given area of pasture receives a urination on the average only once in three or four years, and since the effect persists for probably a year at most

on very deficient soils, it is obvious that animal returns cannot be counted on to maintain the potassium status of the soil or pasture. At present there appears to be no way of overcoming these difficulties, although the "luxury consumption" effect may eventually be solved by the development of slow-acting potash fertilisers; the animal problem, however, appears to admit of no practicable solution.

PRUNING SYSTEMS FOR APPLES

Pruning fruit trees is an art dating back thousands of years. Always the objective has been an improvement of fruit quality and yield, but there have been wide differences of opinion on method. We now know that there is no single pruning system suitable for apples wherever they are grown because variations must be introduced to suit climate, soil, rootstock and variety. As there has been a marked swing in this country from the traditional apple stock (Northern Spy) towards more vigorous stocks the Fruit Research Division laid down a trial eight years ago to find out how best to prune the new, vigorous trees.

Early results show that the Hawke's Bay system is the most promising of methods tested. These trees have three to five vigorous, upright leaders tied to a hoop of wire near the top to prevent breakage, and a series of horizontal branches which carry many lightly-pruned fruiting laterals. A variant of this system, in which a single central leader replaces the group of leaders, will probably become the standard method for trees on semi-dwarfing stocks planted close together in the row. This hedge-row type of planting is just beginning in New Zealand, but it is already popular in some of Europe's most productive orchards.

BIENNIAL BEARING OF APPLES CONTROLLED

Many apple varieties carry a heavy crop one year followed by a light one in the following season. This phenomenon, known as biennial bearing, is one of the fruit-grower's oldest problems as it disrupts marketing and annual income of the industry. If the number of flowers or very young fruitlets is drastically reduced by hand thinning in the year of heavy crop a good crop usually follows in the succeeding year. Hand thinning is impractical at this early period, but it was shown by the Fruit Research Division some years ago that flower or fruitlet thinning with chemical sprays was effective for many apple varieties. To demonstrate the value of this method in reducing biennial bearing a block of Statesman apple trees of marked biennial habit was chemically thinned before each heavy crop during an eight year period. Biennial bearing was practically eliminated, and treated trees produced a total crop 20 per cent greater than that from untreated trees. To secure both more regular and heavier crops is a substantial double gain.

CONTROLLED ATMOSPHERE (CA) APPLE STORAGE

Internal breakdown, a brown discoloration of the flesh, is likely to cause serious wastage among apples held in cool store for more than four months. For this reason it is difficult to supply the home market with ample quantities of first-class apples during spring and early summer. The Fruit Research Division has demonstrated that breakdown can be practically eliminated by applying the English method of gas or controlled atmosphere storage. This consists of storing fruit in

refrigerated gas-tight rooms. Here the apple's normal process of respiration, which converts oxygen to carbon dioxide, brings about changes in the composition of the atmosphere. By simple adjustments it is possible to maintain the atmosphere in CA rooms so that it consists largely of nitrogen gas with a low level of oxygen but a higher than normal quantity of carbon dioxide. When apples are stored in this way the whole ripening process is delayed and they can be held in excellent condition for periods of six or seven months. Last season Golden Delicious, Granny Smith and Sturmer apples were brought out of CA storage in mid December, crisp and firm, with no sign of breakdown or other disorders. Capital cost of CA rooms is higher than for normal cool stores, but it has been found abroad that improved quality and reduction of wastage rapidly offset the higher initial cost.

TOBACCO RESEARCH

Verticillium wilt is potentially the most serious disease of tobacco in New Zealand, as it is the only one which has caused land to go out of production. It does not occur on tobacco in other countries. It is caused by a fungus which carries over from year to year in the soil and is very persistent. The eventual control of the disease will lie in the production of resistant varieties but this is a lengthy process. Sources of moderate resistance have been found in non-commercial varieties and breeding of resistant commercial varieties is proceeding. In the meantime, a short term approach by the Tobacco Research Station has been to try out various chemicals for the control of the disease in the soil. In experimental plots, chloropicrin injected into the soil gave good results over several seasons. The next step was the development of a tractor-mounted applicator for use on a field scale. This was successfully accomplished and, following a season's trial, the outfit was made available to growers last season. Results were very satisfactory, a high degree of control being obtained where the method was carried out properly. The treatment is rather costly but where it can be used to clean up a centre of infection and so protect valuable tobacco land, the expenditure is justified.

WILDLIFE RESEARCH

General ecology of rabbits—A study of a natural rabbit population in a rabbit-proof enclosure at Kourarau in the Wairarapa was initiated by the Animal Ecology Section in January 1958. The purpose was to establish the factors determining the natural population density by means of a detailed analysis of numbers present and of routine behaviour.

The following preliminary results were obtained from the first two years of work. It was found that during the first year the population increased six-fold (from c.4/acre to c.24/acre) but in the second year there was only a further two-fold increase (to c.45/acre). The parasite infestation in the enclosure has proved substantially heavier than amongst rabbits at a very low density outside but not to such an extent as to cause substantial mortality. The frequency of natural predation by harrier-hawks, stoats, ferrets, and feral cats was greater but not in proportion to the increased population density. Rabbits once established displayed extremely sedentary habits, and by day they seldom strayed outside a radius of 50 yd from their warrens. By night, however, particularly as the population increased, many rabbits travelled more than

twice that distance to their feeding grounds. Some young rabbits moved much further before settling, having traversed the length of the enclosure and might presumably have moved even farther if not stopped by the fence. The routine behaviour of the rabbits appeared to be little affected by changes in population density. However, in mid winter a smaller proportion of rabbits was seen by day owing to there being sufficient time for grazing during the hours of darkness. This may explain the often reported sudden daytime appearance of rabbits "from nowhere" in spring in areas where only few rabbits were previously seen in winter. Finally it was observed that rabbits from the thinly populated and regularly controlled neighbouring area outside the enclosure, congregated at night round the fence as if attracted by the dense population inside. This has led to a suggestion that the most effective long-range "bait" for rabbits at low densities when they are most difficult to attract by conventional means, may be a small group of other rabbits; and an experiment is planned to test the feasibility of using this in field control.

Physiology of Rabbits at High Population Density—Recent work overseas suggests that certain rodent populations may be self-regulating, in that individuals living at high population densities produce fewer young and have a high mortality rate. Preliminary work in New Zealand suggests that the above findings are not applicable to wild rabbits, which were found to be heavier and fatter at a density of 23 to the acre than at lower densities. It seems that the rabbit, being a social animal, is adapted to living at high densities, and indeed, in some districts, a fairly high density is required to keep the grass in the short condition preferred by rabbits.

Breeding of Native Rats in Captivity—The successful breeding in captivity of the kiore, or native rat (*Rattus exulans*), by officers of the Animal Ecology Section, opens the way for carrying out research on the biology of this little-known animal and on its reactions to various poisons. Although of no economic importance in New Zealand, this species sometimes causes serious damage to crops—particularly coconuts—on various Pacific islands. Some of the rats reared in captivity have been sent to the Otago Medical School where they are being studied for possible use as laboratory animals.

Lake Monk Survey, Southern Fiordland—A contribution towards understanding the relationships between introduced animals and native forests was made in the above district in collaboration with officers of the New Zealand Forest Service and the Auckland Institute and Museum. It was found that red deer provided the dominant animal influence on the vegetation, the composition of which has already suffered considerable change. There has been an increase in unpalatable plants and the environment is now less favourable for deer. However, it seems that the forest in this particular area is not in danger of being destroyed by deer, even without controlling measures.

The survey also yielded information on the present status of 18 native and seven introduced species of birds and on two small mammals, the stoat and the mouse. An examination of stoat droppings indicated that the stoats were feeding mainly on birds.

SCIENTIFIC LIAISON SERVICE

The Department maintains scientific liaison offices in London and Washington, but the post at Washington has not been filled since 1953 and the office is maintained by a liaison assistant. The officers are responsible for keeping New Zealand research workers advised of the most recent, relevant, and important scientific work being carried out overseas. This advance information assists the Department in its own research programmes and in avoiding duplication of work undertaken elsewhere. The liaison officers have access to the results of research in progress, much of which is on a scale beyond the normal resources of smaller organisations. In addition, liaison officers provide the answers to specific technical inquiries from New Zealand, maintain and establish contacts with overseas research organisations, obtain scientific reports and publications not otherwise readily available, represent the Dominion on specialist committees, assist scientific visitors from New Zealand, and act in an advisory capacity to other official New Zealand representatives overseas.

In London and Washington the Department's representatives are associated with the liaison officers from other parts of the Commonwealth in the formation in each capital of a British Commonwealth of Nations Scientific Liaison Office (B.C.S.O.). This arrangement greatly facilitates cooperation, particularly in major projects of outstanding importance to the Commonwealth.

The Department is indebted to overseas research organisations and other bodies for the assistance they have given so generously to our liaison staff.

INFORMATION BUREAU

The functions of the Information Bureau include the editing and publishing of departmental publications, and the maintenance of the Central Library, Technical Information Section, Translations, Public Relations, and the Photographic and Photocopy Section.

Two complete volumes of the three new journals (which replaced the *New Zealand Journal of Science and Technology*) have now been published, namely, the *New Zealand Journal of Agricultural Research*, the *New Zealand Journal of Geology and Geophysics*, and the *New Zealand Journal of Science*. The first named is published in alternate months and the other two quarterly.

During the year the Bureau has also edited and published 21 bulletins and other publications on behalf of branches of the Department.

The Central Library arranges the book ordering for branches of the Department, operates an inter-library lending system and provides reference facilities for departmental officers. Assistance is given to branches in improving library standards.

The inability during the past two or three years to recruit graduate staff, with training either in science or librarianship, is hampering the full development of the Central and branch libraries. Late in 1959 the Central Library and a number of branch libraries were visited by an overseas specialist (Dr A. D. Osborn) who was conducting a survey of New Zealand book resources on behalf of the New Zealand Library Association; the Department's library system received very favourable mention in his published report.

The Technical Information Section dealt with some 650 important inquiries during the year. Almost half of these were from manufacturers, and about one-third were from Government Departments and local authorities. The Technical Information Officer maintains close touch with scientific officers, and with the Scientific Liaison Offices in London and Washington. Collaboration with overseas information agencies continues and, as a result, an increasing amount of valuable technical literature has been made available to New Zealand.

The *Industrial Bulletin* is published jointly by this Department and the Department of Industries and Commerce. Approximately 300 abstracts and scientific and technical articles were contributed to it during the year by the Technical Information Section. Many requests were subsequently received for further information on the subjects dealt with in the Bulletin.

The Public Relations work of the Department is now being extended. Thirty-eight press releases covering practically every branch of the Department were issued during the year. In addition, special articles were prepared for the press, magazines, etc. This section has also arranged for addresses on the work of the Department to be given to Rotary Clubs, Chambers of Commerce, and Vocational Guidance Officers.

The Photographic Section is giving a wide-range of specialised services to Head Office and to certain branches.

CONCLUSION

The Department has continued to receive generous cooperation from other State Departments, the Cawthron Institute and the universities, overseas scientific organisations, and from both farming and manufacturing interests. The good relations that have prevailed have been much appreciated and have greatly assisted the promotion of the Department's objectives.

In conclusion, I would thank the staff of the Department for their help and cooperation during the year, and also express my personal indebtedness to the Council of Scientific and Industrial Research and its advisory committees for the assistance they have generously rendered on all occasions.

W. M. HAMILTON, Secretary.

BRANCHES

ANIMAL ECOLOGY SECTION

Officer in Charge: Dr K. WODZICKI

PROJECTS

Mammals

Reproduction of Rabbits—Study of seasonal and geographic variations in productivity of rabbit populations.

Parasites of Rabbits—Research on factors controlling distribution and abundance of parasites and on the significance of parasites as a cause of mortality in rabbit populations.

General Ecology of Rabbits—Study of the behaviour and population dynamics of a rabbit population in a 21-acre enclosure in the Wairarapa.

Effect of High Population Density on Physiology of Rabbits—Testing applicability to rabbits of overseas work on rodents suggesting population control through physiological derangements at high population density.

Testing of Research Techniques—Age-determination and census methods for rabbits.

Other Mammals—Studies on the Maori rat in captivity and on the ecological inter-relationships of cats, rats, and birds on Little Barrier Island.

Birds

Rooks—Long-term effects of recent control operations on the rook population of Canterbury.

Gannets—Population dynamics and behaviour.

General Ecology of Specific Areas

Kaingaroa—Significance of birds in control of insect populations in exotic forests.

Western Taupo—Effect of land development on the distribution and abundance of birds and mammals.

Motunau Island—Effects on vegetation and bird life resulting from removal of rabbits (in cooperation with Botany Division).

PUBLICATIONS

Birds, with a Note on the Mammal *Rattus exulans* Peale. In "White Island" (comp. W. M. Hamilton and I. L. Baumgart). *N.Z. Dep. sci. industr. Res. Bull.* 127. 70–82. K. A. Wodzicki and the late F. H. Robertson.

Identification of Rats and Mice in New Zealand. *N.Z. J. Agric.* 98: 365–368. The late J. S. Watson.

Stomach Contents of a North Island Kiwi (*Apteryx australis mantelli*) from the Raetihi District. *Notornis* 8 (5):143–145. P. C. Bull.

Birds of the Hutt Valley. *Proc. N.Z. Ecol. Soc.* 6:52–58. P. C. Bull.

Lake Monk Expedition – An Ecological Survey in Southern Fiordland. *N.Z. Dep. sci. industr. Res. Bull.* 135:75 pp. T. Riney, the late J. S. Watson, C. Bassett, E. G. Turbott, and W. E. Howard.

A Seasonal Sex Difference in the Infestation of Rabbits with the Nematode *Trichostrongylus retortaeformis* (Zeder, 1800). *Nature* 184: 281–282. P. C. Bull.

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The New Zealand Otter. *Rec. Canterbury Mus.* VII (3):175–183. The late J. S. Watson.

Influence of Population Density on the Adrenal and Body Weight of the Wild Rabbit *Oryctolagus cuniculus* L. in New Zealand. *N.Z. J. Sci.* 3:103–120. K. Wodzicki and H. S. Roberts.

ANTARCTIC DIVISION

Superintendent: MR G. W. MARKHAM

FUNCTIONS

Following the Government decision to continue Antarctic research and exploration the Antarctic Division was formed to implement the approved programme. Specifically its functions are:

- (a) To be responsible for the execution and operation of Antarctic activities approved by the Minister;
- (b) To supervise approved non-Government expeditions to Antarctica.
- (c) To maintain an information centre on Antarctic scientific research and exploration.

The annual programme is formulated by the Ross Dependency Research Committee, which advises the Minister in Charge of the Department of Scientific and Industrial Research on New Zealand activities in the Ross Dependency. This Committee comprises representatives of the Government Departments and other organisations participating in Antarctic work.

Responsibility for the scientific details of the approved programme, the procurement of scientific equipment, and the working up of scientific data is the responsibility of other Divisions of D.S.I.R., the New Zealand Meteorological Service, and the Dominion Museum.

PROJECTS

The Division has been responsible for implementing the following activities:

Scott Base—Scott Base was maintained throughout the year with a wintering-over party of 12. The scientific programme comprised the continuation of the studies in meteorology, geomagnetism, seismology, ionosphere, and aurora; upper atmosphere studies in aurora were intensified, and research projects on propagation through the auroral zone, whistlers, and an investigation of the D-layer reflections were continued. A limited amount of glaciological work, ice-current measurements, and tide recording was also undertaken. The organisations participating in the programme are: Geophysics Division, Dominion Physical Laboratory, and New Zealand Oceanographic Institute, all of D.S.I.R., the New Zealand Meteorological Service, and the Physics Department of the University of Canterbury.

Hallett Station—At this joint United States/New Zealand Station New Zealand again provided three scientists to carry out the scientific programme in geomagnetism, ionosphere, seismology, and aurora. One of the three scientists undertook biological studies of the penguin and skua rookeries throughout the year. The participating organisations are: Geophysics Division and Dominion Physical Laboratory of D.S.I.R. and the Dominion Museum.

New Zealand Geological and Survey Expedition—The geological reconnaissance and topographical mapping of the Ross Dependency was extended by surveys of the coastal region of Victoria Land between Cape Wilson and the Beardmore Glacier and extending approximately 50 miles inland. This survey replaced the proposed survey of the Barne Inlet to Shackleton Inlet area, which was foiled by an accident on 19 November 1959 when one of the two sno-cats fell into a crevasse. Lt. Couzens was killed and the party's two geologists were severely injured. The participating organisations were: New Zealand Geological Survey, D.S.I.R., and Department of Lands and Survey.

Biological Investigations—Two biologists were stationed at Cape Royds from October 1959 to late February 1960 to study a complete cycle of the occupation of penguin and skua rookeries during the summer. Participating organisation: Dominion Museum.

Soil Surveys—Two soil scientists undertook a study of the fundamental physical and chemical processes of soil formation under Antarctic conditions. The areas of investigation were the western side of McMurdo Sound, Ross Island, and Hallett Station. Participating organisation: Soil Bureau, D.S.I.R.

Oceanographic and Sea Seismic Surveys—During October 1959 five oceanographers and marine biologists, travelling on HMNZS *Endeavour*, carried out hydrological and biological studies between New Zealand and Macquarie Island. During January and February 1960 a party of six geophysicists and oceanographers, travelling on HMNZS *Endeavour*, carried out surveys in the Ross Sea. The seismic programme consisted of refraction and reflection surveys to determine the thickness of the glacial deposits and sediments in the Ross Sea. The oceanographic programme was directed to bottom surveys over the Pennell Bank and to the north-east down the slope of the Continental Shelf. Throughout the cruises of HMNZS *Endeavour* magnetic measurements were taken with a proton magnetometer. Participating organisations: Geophysics Division and New Zealand Oceanographic Institute of D.S.I.R.

Non-Government Projects

Antarctic Division has been responsible for the logistic arrangements and operational control of the following non-Government parties in Antarctica.

Victoria University of Wellington Expedition—A party of five scientists from Victoria University undertook geological, meteorological, and biological studies in the Dry Valley areas to the west and north of McMurdo Sound. Participating organisation: Victoria University of Wellington.

New Zealand Alpine Club Geological and Survey Expedition—From mid November 1959 to mid January 1960 an eight-man party of geologists and surveyors, organised by the New Zealand Alpine Club, undertook surveys over 1,200 square miles of unexplored territory to the east of the Beardmore Glacier.

LOGISTICS

The Antarctic Division in implementing all the foregoing activities has had logistic support from the Royal New Zealand Navy in the use of HMNZS *Endeavour* to resupply Scott Base and to carry out oceanographic and sea-seismic surveys, and the Royal New Zealand Air Force which reactivated the Antarctic Flight to provide air support to the geological and survey expeditions. The United States Navy again carried the major burden of the transportation of men and supplies by sea and air to Antarctica. The United States Naval Air Squadron, operating in Antarctica, provided essential air support for some of New Zealand's activities and rendered outstanding aid upon the occasions of the sno-cat accident and the Beaver aircraft crash.

APPLIED MATHEMATICS LABORATORY

Director: Dr R. M. WILLIAMS

PROJECTS

Industrial and operational research projects include studies on the preservation of timber; the elimination of wavy-edged timber; the production of plastic foam; and queueing problems in the civil aviation communication system.

In agriculture, statistical work has been done on a variety of problems including spore counts for facial-eczema work; plant therapeutants; distinguishing soil types; entomology; efficiency of hill-country trials; aphid populations; analysis of wool-production data; root rot in hops; several studies on rabbit populations; and mathematical analysis of field-growth data to determine weather effects at different seasons, at different stages of growth, and on interspecific competition.

In genetics, work has been done on the separation of epistatic from additive and dominance variation; incorporation of linkage parameters in mathematical genetical models; theory of mixed sib and random-mating with selection against homozygotes; the significance of all-or-none effects in a diallel cross; components of genetic variance in a selfing experiment; and the inheritance of quantitative characters in ryegrass.

Miscellaneous statistical work includes mud flat and air-pollution studies; work on ironsand deposits; mortar bonding in bricks; a sample survey for the banking system; the analysis of fisheries data; and micro-climatological data.

Mathematical physical work has been done on the decay of pressure in telephone cables; the stress in clay due to moisture, as it affects ceramic work; diffusion of hydrogen in steel; problems in hydrology; and a number of studies in the geothermal project.

Basic mathematical studies include statistical work in ranking problems and cyclic experimental design, and work on the properties of partial differential equations.

PUBLICATIONS

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- Operational Research. *Management* 5:39–41, 1959. H. R. Thompson.
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AUCKLAND INDUSTRIAL DEVELOPMENT LABORATORIES

Director: Mr J. B. BROOKE

PROJECTS

Medical Instrumentation Group—Development of particle counter, initially for the rapid counting of apple cells for Fruit Research Division; development of flow cell and associated transistorised unit for whole blood oximetry and dye concentration measurement, modifications to Melrose heart-lung machine to simplify operation and improve performance; construction of blood pressure recording equipment for Wellington Hospital; modifications to isodose recorder to improve resolution; design and construction of multi-channel oesophageal pressure recording equipment; design and construction of coronary perfusion cannulae for use during open heart surgery; continuing investigation into the mechanism of the freezing of pears; assistance with the bloat research programme of Plant Chemistry Division; design and development of twin channel bronchspirometer and automatic breathing valve for open chest lung function research; and design and construction of cytology pump to facilitate sampling of gastric mucosal cells.

Fuel Group—Examination of grit emission from industrial stacks; tests on feedwater supplies for boilers; boiler efficiency tests; evaluation of operation of individual boilers; investigation of use of steam in industrial plants; and assistance with smoke abatement investigations.

Foundry Group—Investigation of the foundry properties of some New Zealand hard cokes; investigation of impurities in leaded gunmetals; the effects of additions of steel and alloying elements to the cupola charge; the effects of oxygen enrichment of the cupola blast; assistance to foundry industry in evaluation of foundry sands and in overcoming gas porosity in light alloys; and efficiency determinations on industrial cupolas.

Design and Workshop Sections—The design and construction of dust elutriation equipment; the design and construction of spore collectors for facial-eczema investigations; the development of rope gripping drums for tensile testing of nylon and terylene ropes; the design and construction of an automatic machine for the lamination and treatment of dough for cracker biscuits; calculations on the rated capacity of power stamping presses with cast iron main frames; design of automatic machinery for production of latex can seals; strain gauge determinations of stresses in sheet piling during wharf construction; determination of the circulation and skimming efficiency in school-learner swimming baths and assistance with paint tests; the design and construction of a rotary sampling machine for the cast-iron cupola; the balancing of several large motors and subsidiary equipment in paper and softboard-making machinery; investigation of methods of removal of spores from dried grasses; investigation of loads on a plywood press; correction, by redesign, of chatter in pressure relief valve; design and construction of limit and setting diameter measuring gauges for ring-sealed glazed clay pipes; investigation of variation in shell construction on the stresses in a shotgun barrel, using strain gauge techniques; assistance with design and operation of an ampoule washing and filling machine; design of special machine taps, reamers and cutting tools for production engineering; testing of design for an underwater camera case; checks on load-carrying capacity of wringer gears and gear casing in a locally manufactured washing machine; design of a half-ton soil-compaction roller; the design and construction of a magnetic blackboard for the teaching of music notation by a blind teacher; and the design of experimental equipment for the determination of the skin friction of bodies moving in a fluid under varied conditions of surface roughness.

Physics Section—Determination of the freezing point of pears to assist in the long-term storage of the fruit without undue loss; determination of the behaviour of building materials when subjected to various environmental conditions; examination of the effectiveness of several methods of circulating the water in school swimming baths fitted with filtering equipment; and investigation of tenderometers with a view to their standardisation as an effective means of determining crop maturity.

Industrial Liaison and Information Section—Symposia were held in conjunction with the Seddon Memorial Technical College on "Compressed Air in Industry" and "Utilisation of N.Z. Exotic Timber". Appropriate proceedings have been prepared. Lectures on the work of the laboratories have been given to Rotary Clubs, to Technical College

Engineering Instructors, to the Institute of Fire Engineers, and to several other educational and professional groups. Technical lectures on "Medical Instrumentation" and on "Automation" were given to the Waikato Scientific Association. An exhibit showing "Application of Science to the Foundry Trade in New Zealand" was arranged at the Association's annual display. Assistance was given in organisation, servicing, and staffing the UNESCO exhibition "Energy and its Transformations" in Auckland. Information and assistance was given with the following industrial problems—screen printing on shaped objects; modifications to a fish-smoking installation; investigation of failure of die blocks for concrete products; use of spheroidal graphite cast iron in washing machine gears; and improved methods of concrete-post manufacture.

Two larger projects were the investigation of defects in automobile springs manufactured in New Zealand (giving recommendations for the metallurgical and dimensional control necessary), and assistance with the development of new methods of timber utilisation. Two separate firms who are producing polythene piping for farm reticulation have been supplied, in one case, with calculations and master layouts for a circular computer and, in the other case, with simplified logarithmic charts to facilitate flow-rate calculations. Brief lectures have been given to their distributors on the design of installations, using these aids.

Industrial surveys have been commenced in the fields of precision engineering, electronic and instrument engineering, boiler installations, and foundry practice. The results will be presented on punched card indexes.

General Industrial Assistance—Testing of materials for compliance with a specification or to a standard of quality or performance; testing of materials as part of a trouble-shooting investigation or to obtain constants for design purposes; calibration of equipment for industrial control and inspection; calibration of industrial substandards; design, construction, and calibration of test equipment for installation in industry as a means of production control, e.g., ceramic pipe-gauging equipment; tensometer for glue testing; loading devices for laminated trusses; installation of equipment to simultaneously record smoke density, humidity, and temperature from several locations in a bacon-curing plant; design of cathodic protection equipment for several harbour sheet-piling breastworks; and sound level measurements and analysis in a number of industrial plants.

PUBLICATIONS

The Mechanical Activity of the Reticulo-rumen of Cattle. *Proc. N.Z. Soc. Animal Production* 19:23-25. 1959. C. S. W. Reid and J. B. Cornwall.

A Technique for Recording Pressure Changes in the Reticulo-rumen of Cattle, Using Small Electrical Pressure Transducers and a Four-channel Recorder. *N.Z. J. agric. Res.* 3 (1):41-62. 1960. C. S. W. Reid, A. W. Melville, and J. B. Cornwall.

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- Scientific Services to Industry with Particular Reference to Auckland. *N.Z. Engineering* 15 (3):97-100. 1960. J. B. Brooke.

BOTANY DIVISION

Director: Dr E. J. GODLEY

PROJECTS

Herbarium—Maintenance and expansion of indigenous, adventive, and cultivated plants sections of herbarium; accessions of specimens of indigenous plants from Egmont, Nelson Lakes, Mt. Cook, and Fiordland National Parks; and collection and distribution of seeds of indigenous plants.

Botanic Garden—Development of garden continued at Lincoln with provision of more facilities and bringing in of more land; increased amount of plant material under observation, and additional species to the permanent growing reference collection of plants.

Taxonomic Studies—Work on families of Volume I of the revised *Manual of New Zealand Flora* is almost complete; work has commenced on Volume II (Monocotyledons), and the material is being assembled for Volume III (Adventive plants); and revision of indigenous alpine species of *Ranunculus* is in progress.

Vegetation Studies—Vegetation surveys of Nelson Lakes, Mt Cook, Egmont, Tongariro, and Arthur's Pass National Park in progress; aquatic vegetation, and bog and swamp survey continued; and Hutt River catchment survey completed.

Chromosome Studies—Two further contributions to the chromosome atlas of indigenous plants were published.

Quaternary History—Pollen and macrofossil analyses of Chatham Island, sub-Antarctic, and Mokai-Patea peats; pollen morphology of indigenous Podocarpaceae and Umbelliferae; and expansion of permanent reference collection of pollens.

PUBLICATIONS

- Soils and Growth of *Pinus radiata* at Cornwallis, Auckland. *N.Z. J. Sci.* 2:443-472. 1959. I. A. E. Atkinson.
- Forest Variation in the Hutt Catchment. *Proc. N.Z. Ecol. Soc.* 6:41-45. 1959. A. P. Druce and I. A. E. Atkinson.
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- Contributions to a Chromosome Atlas of the New Zealand Flora—2, Miscellaneous Families. *N.Z. J. Sci.* 2:148–156. 1959. J. B. Hair and E. J. Beuzenberg.
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- Index Seminum*, Anno MCMLIX Collectorum.

CROP RESEARCH DIVISION

Director: Dr L. CORKILL

FIELD-CROP PROJECTS

Wheat Breeding—A general-purpose wheat similar to Aotea in yield but with higher baking quality; an early-maturing red-grained rust resistant variety to replace Tainui and Gabo in the North Island; a high-yielding wheat with better baking quality to replace Arawa on high-fertility land; a high-quality wheat like Hilgendorf with greater yield; lines of commercial varieties resistant to mildew; drought resistant wheats for light land; and lines resistant to cereal yellow-dwarf virus.

Wheat Genetics—Inheritance of kernel weight, grain-shattering, protein, mildew resistance, purple grain colour, and production of supernumerary grains. Monosomic inheritance and inter-specific crosses in Gramineae.

Oat Breeding—Lodging-resistant milling oats; lines of commercial varieties resistant to crown rust; and introduction and testing of overseas varieties.

Oat Genetics—Inheritance of hull type and seedling chlorosis.

Barley—Introduction and testing of overseas varieties.

Ryecorn—Breeding for improvement of forage and seed yield of C.R.D. ryecorn.

Potato Breeding—Resistance to blight (*Phytophthora infestans*), scab, and pink rot (*P. erythroseptica*); resistance to viruses A, S, X, Y, and leafroll; and improved agronomic characters.

Virus-free Stocks of Potatoes—Selection of virus-free plants of commercial varieties and maintenance of nucleus stocks; and annual testing of virus-free stocks that are being increased by the Department of Agriculture.

Potato Virus Diseases—Study of the natural spread of virus diseases; study of strains of viruses X and Y; methods of testing for virus content and virus resistance; study of the nature of resistance and of gene action; the effect of environment upon resistance; and study of potato aphid population in Canterbury throughout the growing season.

Potato Blight—Study of blight strains in New Zealand and of their origin; study of the nature of resistance and of gene action; and the effect of environment upon resistance.

Agronomy—Effect of irrigation and other agronomic practices upon potato yields.

Swede Breeding—Resistance to dry rot and club root.

Swede Genetics—Inheritance of split cotyledons.

Rape Breeding—Resistance to aphids.

Turnip Breeding—Resistance to cauliflower mosaic and club root.

Lucerne Breeding—Winter production, resistance to eelworm; and creeping rooted habit coupled with high productivity.

Lucerne Agronomy—Growth rates of varieties; effects of grazing management and plant density on winter production; and soil moisture supplies.

Lupin Breeding—Production of sweet forms with high forage yields; and non-shattering pods.

Linseed—Introduction and testing of varieties.

VEGETABLE PROJECTS

Breeding and Selection—Club-root resistance in cabbage, cauliflower, and brussels sprouts; selection for uniformity in spring cabbage and cauliflower; white rot resistance in onions; type selection in Pukekohe Longkeeper onion; rust resistance in three pole bean varieties; mosaic immunity in wilt-resistant peas; spotted wilt resistance in outdoor tomatoes; and mosaic resistance and leaf mould resistance in glasshouse tomatoes.

Variety Trials—Assessment of growth and of yield and quality characters in five- and six-month winter cauliflower and in sprouting broccoli; trials of United States F.1 hybrid onions; and evaluation of New Zealand rhubarb varieties.

Other Projects—Investigation on varietal differences of susceptibility to mosaic in cauliflower; vegetative propagation methods in brassicas as an aid to breeding programmes; breeding systems in vegetable brassicas; and collection, maintenance, and comparative studies of kumaras from New Zealand, South America, and Pacific area.

BIOCHEMISTRY AND PHYSIOLOGY PROJECTS

Chemical Composition—New aphid-resistant rapes, kumara varieties, and tomato varieties selected for spotted wilt resistance.

Nitrogen Metabolism—Significance of a peptide fraction involved in nitrogen fixation by *Azotobacter vinelandii*; allantoin synthesis in comfrey root cultures; amino acid composition and aphid resistance in rape and swedes; proline metabolism in reproduction; protein development in maturing wheat; the protective action of amino acids upon destruction of purines during acid hydrolysis; and extraction methods for use in studies of nitrogen metabolism using ^{15}N

Enzyme Studies—Peroxidase test for *Phytophthora* resistance in potato seedlings.

Root Culture Studies—Nutrient requirements of potato, wheat, comfrey, and diploid and tetraploid *Lotus* root cultures.

Growth Studies—Phasic elongation in leaves of monocotyledonous plants. An officer at present overseas is studying the effect of growth substances upon ion uptake and transport and is taking part in the isolation and characterisation of an endogenous inhibitor which he discovered in lupin tissues.

NUCLEUS SEED PRODUCTION

Pure seed of 26 field crop varieties has been produced to provide nucleus seed for the seed certification scheme of the Department of Agriculture. Nucleus seed of nine vegetable varieties has been grown for increase and distribution under the Vegetable Seed Approval Scheme.

PUBLICATIONS

The Biochemical Characteristics and Evaluation of Crops. *Proc. N.Z. Inst. of agric. Sci.* 1959:103–109. R. M. Allison.

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- Pollen Sterility in Pukekohe Longkeeper Onions. *N.Z. J. agric. Res.* 2 (3):605-612. D. E. Yen.
- Assessment of New Wilt-Resistant Pea Strains for Market Growing. *N.Z. Commercial Grower* 15 (1):27-29. D. E. Yen and R. J. Casey.
- The Use of Maize by the New Zealand Maoris. *Econ. Bot.* 13:319-327. D. E. Yen.
- The Evaluation of Vegetable Varieties and Breeding Material in New Zealand. In *Cultural Value of Varieties and Breeding Material and its Evaluation*:65-68. Inst. Hort. Plant Breeding, Wageningen. D. E. Yen.

DOMINION LABORATORY

Director: Mr F. J. T. GRIGG

PROJECTS

Cement and Concrete—Investigation of strengths of cements cured by different methods; cement grouts for geothermal bores; barytes concrete for nuclear shielding; methods of evaluating the purity of diatomites; and methods of determining alkalis in cements.

Chemical Engineering—Pilot-plant studies of ion exchange and electrodialysis; concentration of ironsands by wet magnetic methods; prevention of apple scald by diphenylamine; pilot-plant extraction of manool from *Dacrydium biforme*; new-type kiln for hop drying; and dust in flue gases.

Coal—Micro-methods for coal analysis; gas evolved from lignite in stages to 1200°C; atmosphere in locomotive cabs in tunnels; ranking of coals from Taranaki oil drill at 13,000 ft; briquetting of South Island coals; and analysis of gases from oil-well drill.

Food and Drugs—Determination of benzoic acid used as a preservative; identification of colour in confectionery; determination of trace metals in foods; determination of lead in glazed earthenware; and detection of foreign fat in ice cream.

Inorganic Chemistry—Solubility of calcite in H₂O/CO₂ systems at high temperatures; analysis of rubidium and caesium in rocks and waters; ultraviolet absorption spectrum of water; occurrence of arsenic and antimony in rocks; treatment of Hutt Valley water supply; and analysis of ironsands.

Metallurgy—Magnetic separation of titano-magnetites from North Island sand deposits; investigation of corrosion by Whangaehu River and Ruapehu crater waters; investigation of failures of expansion compensators and bursting discs at Wairakei; corrosion by high-temperature waters; and non-destructive inspection of a marine propulsion pinion.

Organic Chemistry—Infrared spectrophotometric study of natural and synthetic amino acids; examination of volatile constituents derived from stored apples; rogor and gusathion insecticide residues on apples and cabbages; nitrogen, potash, magnesium, calcium, and phosphorous content of apple leaves in an investigation of plant nutrition; distribution of arsenic within an organ in cases of death from arsenic poisoning; and infrared methods of distinguishing natural and synthetic elastomers.

Paint and Petroleum—Laboratory and road-service investigations of road-marking paints; quality of interior flat and semi-gloss paints; certification of high-gloss paints; zinc-rich paints for structural steel; study of edge sealers for hardboard weatherboards; fuels for Antarctica; formulation of road-binding materials based on a single grade of bulk bitumen supply; calibration of equipment for Ministry of Works district highways laboratories; and plant-mix for Wellington Airport runway.

Physical Chemistry—Fire hazards in aerial topdressing of sulphur; heat output of thermophilic bacteria in wool; heat balance in spontaneous ignition; calorimetry of slow oxidation reactions; and spectrographic analysis of radioactive minerals.

Wood Chemistry—Structural studies of minor compounds isolated from *Dacrydium biforme* and *D. colensoi* resin; a study of the constituents of *P. radiata* semi-chemical pulping liquor; and an improved infrared method for estimating trans unsaturation in natural lipids.

District Laboratories—Method of reconstructing shattered glass for use in criminal investigations; a bacterial taint in milk; fatal accident in a deep well due to oxygen deficiency; and air and river pollution.

PUBLICATIONS

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- Investigation of Some Ancient Woods. *T.A.P.P.I.* 42:913-920. 1959. D. J. Brasch and J. K. N. Jones.
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DOMINION PHYSICAL LABORATORY

Director: Mr W. H. WARD

PROJECTS

Electron Microscopy—Investigation of facial eczema in conjunction with Plan Diseases Division; the excessive wear of sheep's teeth; the cytology of the spermatogenesis of the cave weta; and the structure of wax on Spanish and New Zealand clovers. To assist other research groups, electron micrographs have been prepared on such things as clay colloids and clay surface structure, taxonomy of streptomycetes from New Zealand soils, the early stages of infection of tobacco mosaic virus, bacteria causing wool staining, zinc oxides, cement particles metal surfaces, etc.

Engineering Seismology—Investigation of bearing wall, frame, and mixed type structures. Examination of multi-storey yield and friction damping. Maintenance of strong-motion earthquake recorders and buildings instrumented for earthquakes to get data on actual earthquake performance.

Heat Transfer—Measurement of thermal conductivities; general advice on thermal insulation and heat problems; investigation into utilisation of solar energy for house heating and domestic hot water supply; and development of models of geothermal systems.

Instrument Development—Testing and calibration of anemometers; design and development of specialised apparatus not available commercially; and instrument technology and automatic control devices.

Optical Design—Theory of lens design; construction of numerous special optical systems.

Plant Physics—Investigation of cell wall growth relating the observed mechanical properties of the cell wall to its fine structure; the physical basis of photosynthesis; and the effects of surface wetting of leaves on transpiration. An electron-spin-resonance apparatus is being built, sensitive enough to detect the presence of free electrons at the early stages of photosynthesis.

Radio Research—Use of a frequency standard in the study of long distance ionospheric propagation at very low frequencies; measurement of ionospheric winds; measurement of radio "whistlers" and similar phenomena; use of radar in the study of auroral ionisation, in conjunction with a wide programme of auroral studies using visual photographic and spectroscopic methods; study of radio propagation through the auroral zone; and study of the lower ionosphere using V.H.F. forward scatter.

Standards—Establishment of standards of physical measurement in length, mass, force, temperature, pressure, photometry, radiation, and air velocity; maintenance of standards of electrical quantities, and the examination and calibration of substandards against the national standards; the setting up of standards of reactance; the development of methods of measuring electrical quantities at radio frequencies; and maintenance of the standard-frequency radio transmissions.

General—Development of apparatus to study the effect of wind on sea waves; tests (mainly electrical) to encourage improved quality in New Zealand commodities; advice on problems in acoustics, studies of transmission of sound in multiple-unit dwellings; calibration of microphones; development of an aspheric grinding machine; and development of an automated plant for industrial heat treatment of metals.

PUBLICATIONS

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Phase Velocity and Group Velocity. *Amer. J. Phys.* 27 (2):120. N. F. Barber.

A Proposed Method of Surveying the Wave State of the Open Ocean. *N.Z. J. Sci.* 2 (1):99-108. N. F. Barber.

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The Calorimetry of Steaming Ground in Thermal Areas. *Amer. Geophys. Union Trans.* 64 (1):123-6. R. F. Benseman.

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- Frequencies of a Flexible Circular Plate Attached to the Surface of a Light Elastic Half-space. *J. App. Mech.* 26 (1):13-17. G. N. Bycroft.
- Intensity Variations of the Cosmic Ray Nucleonic Component. *N.Z. J. Sci.* 2 (3):313-319. M. A. Collins.
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- Studies of the Upper Atmosphere from Invercargill, N.Z. Part 1. Characteristics of Auroral Radar Echoes at 55 Mc/sec. *Ann. Geophys.* 15 (3):377-94. R. S. Unwin.
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- Some Observations of the Radioactivity of Ngauruhoe and White Island Lavas. *N.Z. J. Geol. Geophys.* 2 (1):177-182. R. E. Belin and A. Steiner.
- A Note on Meteors. *Radio & Electrical Review* 14 (4):26. J. Mawdsley.

ENTOMOLOGY DIVISION

Director: Dr W. COTTIER

MAIN PROJECTS

Grass Grub and Oxycanus—A study of biology, ecology, and factors influencing control of these important pests of grasslands. The Division is cooperating in extensive trials which are being carried out on different types of soils throughout New Zealand.

Stem Weevil in Ryegrass—Studies of the biology and habits are being continued. Both chemical and biological control are being investigated.

Cabbage Aphid on Crucifers—This is now the main insect pest on field crucifers. Population dynamics of the aphid, which is also so important in transmission of virus diseases, are being studied.

Insects Associated with Leptospermum Species—A study of manuka blight and its effect on *Leptospermum* species. The field work has been completed and a comprehensive bulletin prepared for publication.

Clover Case-bearer—This insect is a serious pest in white clover seed areas. Chemical and biological control are being studied together with management practices.

Oak Leaf Miner—Two parasites of this pest have been successfully introduced.

Insect Survey—Widespread studies of the insect complex of agricultural crops in the North and South Islands continue, pasture and fodder crops being the main present concern.

Biting Flies—Elimination of breeding sites rather than the control of the flies on stock appears to be the best solution to this problem. Alternative means of preventing breeding in ensilage stacks are being investigated.

Development of Forecasting Scheme for Orchard Pests in Nelson—This experiment, which is designed to warn growers concerning the prevalence of codling moth and leaf-roller, is being continued.

Study of Nematodes of Plant and Soil—The officer in charge of this project is prosecuting nematode studies in England and the field work in New Zealand is temporarily in abeyance.

Army Worms Damaging Pasture and Crops—Biological investigations are continuing. A feature of the work in the current year, is the assessment of the relative importance of the two species present in different districts of the North and South Islands.

Biological Control of Mexican Devil Weed—The stem gall fly from Australia has been successfully established.

Black Beetle—Life history and seasonal studies have been completed on this pest of Auckland coastal pastures. A satisfactory method of chemical control has been developed.

Scale Insects on Apple Fruits—Studies of these are being made in the Nelson and Blenheim districts in collaboration with the Department of Agriculture. Every endeavour is being made to eliminate this serious problem on apple fruits. Biological control of the species concerned is being attempted.

Moth in Maize—A field survey in the Gisborne area has been carried out to determine the extent of infestation. Preliminary work on chemical control has been begun.

White-fringed Beetle—This insect is becoming a serious pest of agricultural and horticultural areas in the North Island. An investigation of its life and seasonal cycles has been commenced.

Scale Insects of the Family Eriococcidae—Revision of this group of scale insects is well advanced; many new species having been discovered.

Cocksfoot Seed Thrips—This insect is responsible for low germination in cocksfoot seed and studies are being made in an endeavour to control it.

Sandflies—Work is being done on the distribution, breeding places, and taxonomy of the sandflies of New Zealand, and their relationship to other southern hemisphere species.

Study of the Spermatogenesis of the Cave Weta and the Influence of X-Radiation on it—This is being studied with the aid of the electron microscope.

Maintenance and Development of Insect Reference Collection—Collecting trips have been made during the year to various districts of the North and South Islands and as a result, over 4,000 specimens have been added to the collections.

Identification Service and Advice Concerning Control of Insects—Over 200 specimens were received through the post for identification and advice concerning control. In addition, many local inquiries were handled.

OTHER PROJECTS

Leafsheath miner in ryegrass; virus and bacterial control of insects; biological control of flies; insect pests of Cook Islands (mainly of citrus); fly control in Niue Island; systematics of Melolonthinae, including the larvae, and of Thynninae; systematics of aphids and scale insects in general; taxonomy of larval lepidoptera; and biological control surveys.

PUBLICATIONS

Natural Enemies Can Control Insect Pests. *The N.Z. Young Farmer* 11:121-123. 1959. Anon.

Insect Survey Reveals New Species and Presence of Unrecorded Migrants. *Ibid.* 12:47-49. 1960. Anon.

The Insect Complex of Sown Pastures in the North Island—

III—The Diptera as Revealed by Summer Sweep-sampling. *N.Z. J. agric. Res.* 2:741–762. 1959. R. A. Cumber and R. A. Harrison.

IV—The Coleoptera as Revealed by Summer Sweep-sampling. Ibid. 2:763–772. 1959. R. A. Cumber.

V—The Hymenoptera as Revealed by Summer Sweep-sampling. Ibid. 2:874–897. 1959. R. A. Cumber.

VI—The Psocoptera and Neuroptera as Revealed by Summer Sweep-sampling. Ibid. 2:898–902. 1959. R. A. Cumber.

VII—The Thysanoptera as Revealed by Summer Sweep-sampling. Ibid. 2:1123–1130. 1959. R. A. Cumber.

VIII—The Orthoptera as Revealed by Summer Sweep-sampling. Ibid. 2:1131–1136. 1959. R. A. Cumber.

IX—The Lepidoptera as Revealed by Summer Sweep-sampling. Ibid. 3:24–33. 1960. R. A. Cumber.

Preliminary Flight Records of Diptera Taken with a Modified Rothamsted Light Trap Operated at Paiaka. *N.Z. J. Sci.* 2:237–239. 1959. R. A. Cumber and R. A. Harrison.

Serious Outbreak of the Aphid *Rhopalosiphum padi* (L.) in North Island Wheat, Oat, and Barley Crops During 1958. *N.Z. J. agric. Res.* 2:773–784. 1959. R. A. Cumber and D. H. Todd.

Distributional and Biological Notes on Sixteen North Island Species of Formicidae (Hymenoptera). *N.Z. Ent.* 2 (4):10–14. 1959. R. A. Cumber.

A Record of *Xenophyes cascus* Bergroth (Homoptera: Coleorrhyncha) from the Waewaepa Range. Ibid. 2 (4):33. 1959. R. A. Cumber.

Clover Case-bearers. *N.Z. J. agric.* 99:523–524. 1959. L. J. Dumbleton.

Notes on Australian Thynninae—

IV—The Morphology of *Thynnoides rufithorax* Turner with Notes on the Prepupal Larva and the Cocoon. *Proc. Linn. Soc. N.S.W.* 84:391–399. 1959. B. B. Given.

V—*Aeolothynnus multiguttatus* Ashmead and *Iswaroides koebelei* Ashmead. Ibid. 84:400–402. 1959. B. B. Given.

Argentine Stem Weevil Damage to Ryegrasses in the North Island. *N.Z. J. agric.* 100:79–81. 1960. J. M. Hoy.

Collection of *Hylemyia seneciella* (Meade). (Diptera: Muscidae) in 1959 Season. *N.Z. J. Sci.* 3:100–102. 1960. J. M. Hoy.

Recent Developments in Control of Some Pasture Pests. *Sheepfarming Annual.* 85–88. 1959. J. M. Kelsey.

Spiral Segmentation in Two Species of New Zealand Weta (Orthoptera, Gryllacridoidea, Hemicidae). *Trans. roy. Soc. N.Z.* 86:393–394. 1959. G. W. Ramsay.

Notes on the Ecology of Some Cicadas in the Wellington District. *N.Z. Ent.* 2 (4):29–30. 1959. G. W. Ramsay.

Notes on a Preliminary Investigation into the Habits and Life Cycle of *Copris incertus* Say (Coprini: Coleoptera) in New Zealand. *N.Z. J. Sci.* 3:8–14. 1960. W. P. Thomas.

Incidence and Parasitism of Insect Pests of Cruciferous Crops in the North Island—Evaluation of Data, 1955–58 Seasons. *N.Z. J. agric. Res.* 2:613–622. 1959. D. H. Todd.

- The Apple Leaf-curling Midge *Dasyneura mali* Kieffer, Seasonal History, Varietal Susceptibility, and Parasitism 1955-58. Ibid. 2:859-869. 1959. D. H. Todd.
- Black Beetle *Heteronychus sanctae-helenae* Blanch. in Pastures in New Zealand. Ibid. 2:1262-1273. 1959. D. H. Todd.
- Virus Disease Effectively Controls White Butterfly. *N.Z. J. agric.* 100:83-85. 1960. D. H. Todd.
- A Record of Sound Produced by the Larvae of *Tetrorrea cilipes* White (Coleoptera:Cerambycidae). *N.Z. Ent.* 2 (4):25-27. 1959. J. I. Townsend.

FATS RESEARCH LABORATORY

Director: Dr F. B. SHORLAND

PROJECTS

General Investigations on Animal Fats with Special Reference to those of Meat and Butter—Isolation and identification of minor constituents including branched-chain fatty acids, *n*-odd numbered carbon fatty acids and unsaturated fatty acids; glyceride structure; variations in the fatty acid composition of animal fats in different tissues and at different stages of growth; changes in carcase composition in respect of fat, crude protein, and water as influenced by age and diet; and comparative studies on the fatty acid constituents of vegetable and marine fats.

Fat Metabolism in Ruminants—The effect of the rumen on dietary unsaturated fatty acids; the relationship between the dietary and depot fats of ruminants; the use of labelled intermediates to determine the origin of *n*-odd numbered and branched-chain fatty acids in milk and depot fats of ruminants; and the *trans*-unsaturated acid contents of liver and faecal lipids.

Nutritional Significance and Fate of Minor Constituents of Dietary Animal Fats—Aspects of this general problem being studied in association with the Nutrition Research Department of the Medical Research Council include: (a) relationship between certain lipid constituents, such as branched-chain fatty acids, cholesterol deposition, and atherosclerosis, and (b) fate of branched-chain fatty acids in the body.

Nature of Phospholipids in Animal Products—The preparation of pure phospholipid fractions from meat and milk products to determine their composition and their role in the keeping properties and quality of these products.

Rancidity in Animal Fats—Nature of the compounds responsible for the Kreis and thiobarbituric acid tests used to detect incipient rancidity.

Industrial Utilisation of Fats and Fatty Oils—The composition of tall oil from the New Zealand paper industry with a view to its utilisation; modification of the properties of animal fats to widen their usage; development of methods for the synthesis of triglycerides of known constitution; the synthesis of emulsifying agents, such as monoglycerides, from tallow and plastic fatty coatings from acetoglycerides; and the production of detergents from locally available raw materials.

Development of New Techniques for the Investigation of Fats—The application of gas-liquid partition chromatography to the study of fatty acid composition using improved methods for detection and estimation; and simplified methods for the preparation of methyl esters.

Investigations on the Composition of Pasture Lipids and the Lipids of Associated Micro-organisms—The composition of the chloroplast lipids of red clover are being investigated as part of the major project on bloat being carried out by the Plant Chemistry Division at Palmerston North. In addition the lipids of micro-organisms including those of *Pithomyces chartarum* (synonymous with *Sporidesmium bakeri*) found associated with pasture and of possible significance in relation to facial eczema are being investigated.

PUBLICATIONS

Isolation and Identification of the High Molecular Weight Saturated Fatty Acids of Butterfat. *J. Dairy Res.* 26:190–195. R. P. Hansen, F. B. Shorland, and N. J. Cooke.

Gas-liquid Chromatography: Retention Volumes of the Methyl Esters of Fatty Acids with Special Reference to *n*-odd-numbered *iso* and (+) — *anteiso* Acids. *J. Chromatog.* 2:547–551. J. C. Hawke, R. P. Hansen, and F. B. Shorland.

New Zealand Tall Oil: Isolation and Identification of *n*-heptadecanoic Acid. *Chem. and Ind.* 48:1516–1517. N. June Cooke and R. P. Hansen.

The Fatty Acid Composition of *Rhodotorula graminis* fat. *Arch. Biochem. Biophys.* 81:346–352. L. Hartman, J. C. Hawke, F. B. Shorland, and M. E. di Menna.

The Effect of Curing and Smoking on the Quality and Yield of Lard. *N.Z. J. Sci.* 2:388–392. L. Hartman.

Hydrolysis of Isopropylidene Glycerol Esters of Fatty Acids. *J. Chem. Soc.*:4134–4135. L. Hartman.

Trans-unsaturated Acids in the Depot Fats of Ruminants and Non-ruminants. *Nature* 184:2024. L. Hartman and F. B. Shorland.

A Note on the Acetone-soluble Lipids of Forage Grasses and Clovers. *N.Z. J. Sci.* 2:273. R. O. Weenink.

Further Studies on the Metabolism of (+) — *anteiso* Acids in the Rat with Special Reference to (+)-12-methyltetradecanoic and (+)-14-methyltetradecanoic Acids. *Biochem. J.* 73:594–596. T. Gerson, F. B. Shorland, Y. Adams, and M. E. Bell.

The Role of *n*-valeric Acid in the Synthesis of the Higher *n*-odd Numbered Fatty Acids in Bovine Milk Fat. *Ibid.* 74:366–368. T. Gerson, J. C. Hawke, F. B. Shorland, and W. H. Melhuish.

The Fatty Acids of Phosphatidylethanolamine and Phosphatidylcholine from Hen's Egg. *Ibid.* 71:588–592. J. C. Hawke.

FRUIT RESEARCH DIVISION

Director: Mr J. D. ATKINSON

PROJECTS

Determination of Fertiliser Requirements of Fruit Trees—Field fertiliser trials and application of leaf analysis to orchard problems. Trace element deficiencies.

Orchard Soil Management—Use of grass and clover swards as opposed to clean cultivation.

Application of Hormones in the Orchard—Use of hormones for increasing fruit set, prevention of fruit drop, thinning various fruits, and control of biennial bearing.

Storage of Apples and Pears—Methods for controlling superficial scald, internal breakdown, Jonathan spot, and wilt. Controlled atmosphere storage of New Zealand apple varieties.

Factors Affecting Storage Quality of Apples—Effects of therapeutants, chemical thinning, and tree nutrition on storage quality of apples. Methods for increasing cell number in apples.

Tree Nutrition—Elements present in xylem sap, entry of nutrients through leaves, and mechanism of phloem transport.

Development of Apple Fruit—Cell division factor and hormones present in young fruits. Effects of leaf-fruit ratios on cell number in fruits.

Nitrogen metabolism in Plants—Utilisation of organic nitrogen compounds as sole nitrogen source for growth of plant tissue. Metabolism of ureides and urea in plants.

Plant Tissue Culture—Development of techniques. Factors affecting growth of apple fruit tissue in sterile cultures.

Variety Testing—Trials include some 700 imported apple varieties, small blocks of promising local seedlings of peach, plum, feijoa, and Chinese gooseberry, and a small number of imported apricots, citrus, peaches, and subtropical fruit.

Rootstock Testing—Long-term trials of selected apple stocks worked with six scion varieties; plum stocks budded with three varieties; citrus stocks worked with four varieties; pear stocks budded with one variety; and Chinese gooseberry stocks. Testing apple stocks for *Phytophthora* resistance.

Citrus Breeding—Production of improved lemons and citrus hybrids suitable for local conditions.

Fruit Descriptions—Formal description and classification of apples and Japanese plums grown in New Zealand.

Tree Training—Methods of shaping apple trees on stocks of varying vigour.

Fruit Tree Viruses—In cooperation with Plant Diseases Division, identification of fruit viruses, virus effects on tree growth and yield, and indexing budwood trees.

Frost—Methods for reducing frost damage in orchards.

Miscellaneous—Bird-scaring devices, and physiological diseases.

PUBLICATIONS

Budwood for the Federation Nursery. *Orchardist of N.Z.* 32:99. 1959. J. D. Atkinson.

Certification of Therapeutants and Plant Hormones, 1959 ed. *N.Z. Dep. sci. industr. Res., Inf. Sér.* 13. 1959. E. E. Chamberlain and J. D. Atkinson.

Cherry Variegation in New Zealand. *N.Z. J. agric. Res.* 2:938-944. 1959. J. D. Atkinson, E. E. Chamberlain, and J. A. Hunter.

Corky Pit Threatened Young Fruit Industry. *N.Z. Young Farmer* 12:37-38. 1960. J. D. Atkinson.

Note on a Modification in Technique for Inactivating Apple Mosaic Virus in Apple Wood by Heat Treatment. *N.Z. J. agric. Res.* 2:945-946. 1959. J. A. Hunter, E. E. Chamberlain, and J. D. Atkinson.

Vigorous Apple Stocks Fail on Otago Shingle. *Orchardist of N.Z.* 33:46-7. 1960. J. D. Atkinson and G. E. Roberts.

Factors Affecting Growth and Distribution of Kauri (*Agathis australis* Salisb.)—

Part I—Effect of Light on the Establishment of Kauri and *Phyllocladus trichomanoides* D. Don. *Aust. J. Bot.* 7:252-267. 1959. R. L. Bielecki.

Part II—Effect of Light Intensity on Seedling Growth. *Ibid.*, 268-278. 1959. R. L. Bielecki.

Part III—Effect of Temperature and Soil Conditions. *Ibid.*, 279-294. 1959. R. L. Bielecki.

The Appleby Experiments: a Series of Fertiliser and Cool-storage Trials with Apples in the Nelson District, New Zealand. *N.Z. Dep. sci. industr. Res. Bull.* 129. 1959. L. W. Tiller, H. S. Roberts, and E. G. Bollard.

Urease, Urea and Ureides in Plants. In *Utilization of Nitrogen and its Compounds by Plants; Thirteenth Symposium of the Society for Experimental Biology*. Cambridge, University Press, 1959. E. G. Bollard.

Freyberg—a New Apple Variety. *N.Z. J. agric. Res.* 2:1085-1086. 1959. D. W. McKenzie and H. M. Mouat.

Freyberg—a New Apple of Quality. *Orchardist of N.Z.* 32:257. 1959. D. W. McKenzie and H. M. Mouat.

Red Apples Preferred. *Ibid.* 32:225-226. 1959. H. M. Mouat.

The Use of Diphenylamine and other Chemicals to Control Superficial Scald of Apples. *N.Z. J. agric. Res.* 2:953-970. 1959. C. A. S. Padfield.

Control of Superficial Scald. Picking Dates for Granny Smith are Important. *Orchardist of N.Z.* 32:285. 1959. C. A. S. Padfield.

GEOPHYSICS DIVISION

Director: Dr E. I. ROBERTSON

PROJECTS

Magnetic Survey—Continuous recording and analysis of the earth's magnetic field at Apia, Amberley, Scott Base, and Hallett Station; study of secular variation for preparation of magnetic charts for navigation purposes; relationship of earth current and magnetic effects; upper atmospheric disturbances produced by the Johnston Island high altitude nuclear explosions completed; magnetic survey of the New Zealand coast for the Marine Department; and magnetic characteristics at Scott Base and Hallett Station.

Geophysical Observatory—Continuous recording and analysis of ionospheric conditions at Rarotonga, Christchurch, Campbell Island, Hallett Station, and Scott Base; true height analysis of ionospherically calm days at Christchurch; true height investigations at the conjugate stations of Maui and Rarotonga; analysis of occurrence of sporadic E at all stations; ionospheric storm conditions at low, temperate, and high latitudes; radio propagation within New Zealand for the Post Office; ionospheric effects of the high altitude nuclear explosions at Johnston Island completed; relationship between auroral forms and E-region phenomena at Antarctic latitudes; and improvements to ionospheric equipment.

Continuous recording and analysis of the hard component of cosmic radiation at Christchurch; and meson telescope investigations at Invercargill and Christchurch.

Seismological Observatory—Continuous recording and analysis of earthquake data at New Zealand, Antarctic, and Pacific stations; maintenance of New Zealand time service; IGY longitude-latitude project completed in 1959; seismicity and crustal structure of New Zealand and Antarctica; seismic travel times in the New Zealand region; and analysis of ScS amplitudes at Wellington.

Geophysical Survey—Crustal structure of New Zealand; gravity surveys in New Zealand and Antarctica; seismic investigations for Ministry of Works, North Canterbury Catchment Board, and Wellington Harbour Board; paleomagnetism; analysis of Scott Base and Hallett Station seismograph, auroral, solar radiation, and tide gauge data completed; theory of the growth of continents completed; development and use of proton magnetometer in New Zealand and Antarctica; seismic investigations in the Ross Sea; elastic and flow properties of rocks; rock flow applied to New Zealand structure; and elastic propagation studies.

Volcanological investigations at the Chateau; Wairakei heat flow and heat storage; two-phase flow in boreholes; heat flux survey of North Island; fundamental study of heat sources and hydrothermal systems; seismicity of the thermal area; and various projects directly related to the Wairakei geothermal power project.

PUBLICATIONS

Microseisms at Scott Base. *Nature* 183:1760–1761. T. Hatherton and R. H. Orr.

Disturbance in the Ionospheric F-Region Following the Johnston Island Nuclear Explosion. *Ibid.* 184:32–33. C. H. Cummack and G. A. M. King.

Magnetic Effects Resulting from Two High-Altitude Nuclear Explosions. *Ibid.* 184:B.A. 34/51 – B.A. 52. J. A. Lawrie, V. B. Gerard, and P. J. Gill.

Radiation Balance at Scott Base. *Ibid.* 184:541–542. D. C. Thompson and W. J. P. Macdonald.

Palaeomagnetic Studies of Cenozoic Volcanic Rocks in New Zealand. *Ibid.* 184:883–884. D. S. Coombs and T. Hatherton.

Diurnal Variation of Aurora and Geomagnetic Disturbance at New Zealand Antarctic Stations. *Ibid.* 184:889–890. T. Hatherton and G. G. Midwinter.

- Sea-level Recordings at Scott Base, Antarctica, 1957. *N.Z. J. Geol. Geophys.* 2:297-314. W. J. P. Macdonald and A. L. Burrows.
- On Some Offshore Seismic Refraction Profiles in the Cook Strait, Tasman Bay, and Golden Bay Areas of New Zealand. *Ibid.* 350-354. C. B. Officer.
- Disturbance in the Ionospheric F-Region Following the Johnston Island Nuclear Explosion. *Ibid.* :634-41. C. H. Cummack and G. A. M. King.
- Geological Structure and Volcanism of the Taupo-Tarawera District. *Ibid.* :654-684. N. Modriniak and F. E. Studt.
- Magnetic Survey of the Wairakei Hydrothermal Field. *Ibid.* :746-754. F. E. Studt.
- The New Zealand Primary Gravity Network. *Ibid.* 3:41-68. E. I. Robertson and W. I. Reilly.
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GRASSLANDS DIVISION

Director: Dr P. D. SEARS

PROJECTS

Plant Breeding and Genetics—Maintenance and improvement of the following species and strains; perennial ryegrass, Italian ryegrass, short-rotation ryegrass, cocksfoot, timothy, white clover, broad red clover (cowgrass), Montgomery red clover, *Lotus uliginosus*, *Lotus corniculatus*, zigzag clover, long-rotation ryegrass, tall fescue, and hybrids with perennial ryegrass. Improved strains of the first eight of the above species have already been released and are under Government certification, but further improvement work is being carried out on them as well as on those not yet released. The first nucleus seed of the new long-rotation ryegrass has been harvested. This is being used for widespread field trials by this Division and by the Department of Agriculture, and seed multiplication is continuing. In addition, single plant and sward comparisons are under way of several other species and strains, particularly of strawberry clover, subterranean clover, and meadow fescue. Other projects are: the production of a white clover strain that breeds true for an easily

identifiable leaf marking; the production genetics of ryegrass; the production and study of polyploids in red clover and *Lotus*; examination of certain Spanish strains of white clover for their winter growth potential and their ability to fix nitrogen in the winter and, by crossing with selected New Zealand strains, to incorporate these attributes into the present pedigree New Zealand strains; study of the compatability of different species and strains of pasture plants, with the growth of certain fungi, particularly *Pithomyces chartarum* (synonymous with *Sporidesmium bakeri*); in collaboration with Plant Chemistry Division and Fats Research Laboratory, the testing of plant extracts for toxicity to various micro-organisms; and improvement in techniques for the certification of bred strains:

Soil Fertility—Survey of build-up of organic matter and organically bound nutrients in major North Island soil types under pasture; differential uptake of nutrients by pasture plants and the mechanisms involved; sulphur nutrition of red and white clovers; major and minor element effects on establishment of clovers on Wharekohe silt loam, a Northland "gumland" soil; rate of increase of soil fertility under different pasture systems, and the rate of decrease under cropping; and effects of nitrogen and mineral fertilisers on pasture yield and composition.

Pasture Ecology—Seed dormancy of pasture grasses; buried seed populations of weeds and pasture species; seedling growth under different environments; time of change to and the period of flowering of different pasture grasses; pasture establishment and pasture mixtures; effects of grass grub and Argentine stem weevil on pasture productivity; effects of grazing intensity on seasonal production, and relationships with leaf area, chlorophyll content, and total light interception; effects of sheep treading on pasture and soil; use of chemical weedkillers and soil fumigants; pasture management on farmlet bases on both lowland and hill country; collaboration with Plant Chemistry Division on hogget ill-thrift trials; development of pastures on Northland "gumland" soils; soil-pasture-animal cycle of production; and collaborative trials with Crop Research Division on new potato and wheat varieties grown on high fertility soil at Palmerston North.

Substations—At Kaikohe, Lincoln, and Gore, progeny testing on single plant and plot bases of the new long-rotation ryegrass, and other species and strains under improvement. Paddock scale comparisons under grazing of the productivity of our main species and strains, and also to test the reactions of new strains to variations in grazing intensity at different seasons. Fertiliser trials for local soil conditions and for assessment of local potential in relation to climate and soil. At Te Awa hill-country area a new experimental programme has been started to measure effects of stocking intensities, cattle and sheep combinations, and heavy phosphate fertiliser, both on animal thrift and on pasture productivity and also in relation to soil conservation.

PUBLICATIONS

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 Root Anatomy of Grasses and Clovers. *Ibid.* 2:329-41. Kathleen Soper.
 Pastures and Soil Fertility. *Proc. 20th Conf. N.Z. Grassl. Assn.*:41-9.
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- The Effects of Frequent Hard Grazings at Different Times of the Year on the Productivity and Species Yield of a Grass-Clover Pasture. *Ibid.* 2:125-36. R. W. Brougham.
- Factors Influencing Survival of Strains of Ryegrass during the Summer. *Ibid.* 3:185-93. Renate Lucanus, K. J. Mitchell, G. G. Pritchard, and D. M. Calder.
- Perspectives in Pasture Plant Breeding in New Zealand. *Proc. 21st Conf. N.Z. Grassl. Assn.* P. C. Barclay.

HOP RESEARCH STATION

Superintendent: Dr R. H. J. ROBORGH

PROJECTS

Breeding—Study of botanical characters to aid differentiation of hop varieties; the introduction and evaluation of hop varieties from overseas; the breeding of high-quality hop varieties resistant to root rot (*Phytophthora* sp.); the technique of testing for susceptibility to root rot at the seedling stage as an aid to breeding; the technique of rapid propagation of promising seedlings; and the production and evaluation of polyploids.

Ecology and Physiology—Study of the influence of the method of planting and of the quality and treatment of the planting material, or of the established root stock, on the development of the hop plant; the effect of the method of growing and of climatic conditions on the development of the hop plant and on the occurrence of root rot.

Studies of the response of the hop plant to environmental factors—these investigations have now arrived at the stage where the average hop yields of the district can be predicted at flowering.

INFORMATION BUREAU

Officer in Charge: Mr N. A. MARRIS

FUNCTIONS AND PROJECTS

The responsibilities of the Information Bureau include the editing and publishing of three scientific journals and of other departmental publications, the provision of a central library service (including reference facilities, cataloguing, inter-library lending, book ordering, and assistance to branch libraries), and the maintenance of a technical information section, a publicity section, a photographic section, and a photocopy service. In addition, a *D.S.I.R. Newsletter* is issued each month for departmental information, and certain translation work is undertaken.

PUBLICATIONS

The *New Zealand Journal of Agricultural Research* is published in alternate months; the *New Zealand Journal of Geology and Geophysics* and the *New Zealand Journal of Science* are published quarterly.

The Bureau has also, during the year, edited and published 21 bulletins and other publications on behalf of the Department and its branches.

Publications by Officers in Head Office comprise:

The Appleby Experiments: a Series of Fertiliser and Cool-storage Trials with Apples in the Nelson District, New Zealand. *N.Z. Dep. sci. industr. Res. Bull.* 129, 1959. L. W. Tiller, H. S. Roberts, and E. G. Bollard.

History. In "White Island" (Comp. W. M. Hamilton and I. L. Baumgart). *N.Z. Dep. sci. industr. Res. Bull.* 127, 14–24. Jean Luke.

Report of the Department of Scientific and Industrial Research for the Year Ended 31 March 1959.

INSTITUTE OF NUCLEAR SCIENCES

Director: Mr T. A. RAFTER

PROJECTS

Sulphur isotopes; radiocarbon dating; $^{13}\text{C}/^{12}\text{C}$ isotopic variations in nature; carbon isotopic exchange rates; radioactive well-logging; ^{14}C natural variations; cosmic ray variations; tritium in nature; radioactive fall-out; potassium-argon age measurements; energy transfer mechanisms; theoretical studies; isotope enrichment; radiation research; sewerage tracing; radioactive hazards evaluation studies; and accelerator physics

PUBLICATIONS

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- Some Observations on the Radioactivity of Ngauruhoe and White Island Lavas. *N.Z. J. Geol. Geophys.* 2:177-182. R. E. Belin and A. Steiner.
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NEW ZEALAND GEOLOGICAL SURVEY

Director: Mr R. W. WILLETT

REGIONAL PROJECTS

Geological—Field work on regional bulletin areas is now showing the impact of four-mile work, there being a decreasing amount of regional bulletin work under way. Field work has been completed in the Papatowai and Hokonui subdivisions. This years regional geological programme in the Antarctic was not fully completed owing to unfortunate aircraft and sno-cat accidents.

Paleontological—Mesozoic belemnites project, together with work on New Zealand ammonites at the Sedgwick Museum, has now been completed and is being prepared for publication. Work on the fossils of the Triassic-Jurassic continues and concerns regional work in widely scattered areas of New Zealand. There is continuing work on various groups in the Tertiary and a continuing examination of field collections arising from four-mile mapping.

Foraminiferal studies in the Oamaru region have been completed and Part I is ready for publication.

Interest is being shown in fossil pollens and spores as reflected in the increasing number of samples being examined. The project on past vegetation and climatic history is reaching an advanced stage of preparation. New techniques of extracting pollens from indurated material are increasing the range of pollen and spore work, consequently increasing the amount of assistance to regional mapping.

Petrological—Petrological studies are in progress on the regional rocks of the volcanic area, especially the ignimbrites. Regional study of other volcanic rocks of the North Island is continuing. An examination of petrological specimens in connection with regional mapping continues to occupy considerable time.

Coal—The systematic study of the New Zealand coalfields has now been brought to a conclusion with that of Waikato coalfield, which has now been completed and is being assembled for publication.

Four-mile Project—The four-mile project is, as expected, now taking a greater share of the Geological Survey's time than ever and will continue to do so for a year or two yet. Sheet 21 (Christchurch) and sheet 27 (Fiord) were published during the year. Field work and compilation have been completed and draughting is well advanced on sheets 2B (Barrier), 4 (Hamilton), 11 (Dannevirke), and 8 (Taupo). Field work and compilation have brought the following sheets to the stage where they are ready for the draughtsman: Sheet 1 (North Cape), 2A (Whangarei), 12 (Wellington), 13 (Golden Bay), 16 (Kaikoura), and 23 (Oamaru). Field work and compilation are proceeding on sheets 7 (Egmont), 15 (Buller), 18 (Hurunui), 22 (Wakatipu), 26 (Stewart Island).

One-mile Project—During the year sheet N85 (Waiotapu) was published. Field work and compilation of N94 (Wairakei) has been completed, and is in progress for N76 and N77 (Rotorua and Tarawera). This project is expected to proceed steadily until the four-mile project is completed.

Geochemistry—During the year a geochemical laboratory was established in conjunction with the Chemistry Department, University of Otago. An officer has been appointed and is continuing with high pressure/high temperature studies already initiated in the Chemistry Department. Initially this work is an attempt to understand the mineralogical processes and changes taking place in certain rock types under controlled pressures and temperatures, with particular relation to the geothermal areas.

SPECIAL PROJECTS

Phosphate Search—Joint search with the Bureau of Mineral Resources, Geology and Geophysics, Canberra, continued this year with a visit to Fiji, Tonga, and adjacent islands. Results have again proved negative. The only remaining islands to be examined are those of the Northern Cook Group.

Glaciology—Glaciological work on the Tasman Glacier continues. Glaciological work and ice studies have been undertaken in the McMurdo Sound region and experience gained there should be of considerable value on the New Zealand glaciers.

Pleistocene History—Mapping of Pleistocene deposits in both North and South Islands has been merged to a certain extent into the four-mile programme, although it is a particularly important field of New Zealand geological history. Detailed type ash shower sections have been mapped and material is now complete and ready for publication.

"Geology of New Zealand"—Planning of a comprehensive "Geology of New Zealand" to be published in 1964 together with an accompanying new geological map on 1:1,000,000 scale, has been formulated. This project, now under way, involves all Geological Survey officers and other related branches of the D.S.I.R.

Paleontology—Study of microfaunas and macrofaunas of the Otaian Stage is in progress. A microfaunal and macrofaunal study of the Southland Series at Clifden has been commenced. A study of Tertiary corals, commenced by Dr Donald F. Squires, Fulbright scholar, has now been completed. A re-evaluation from the microfaunal point of view, of the Cretaceous-Tertiary boundary problem has been completed as a contribution to world discussion.

Quaternary Tectonics and Photo-geology—The recent action of the Department of Lands and Survey in placing within the New Zealand Geological Survey No. 2 photo library, has advanced the photo-geology project enormously. This means that a complete collection of all vertical photographs taken for aerial mapping purposes is available within the Geological Survey. This library is being continuously added to and its value is thus further enhanced. The study of Quaternary tectonics is directly associated with photo-geology and has been further assisted throughout the year, together with structural geological projects, by the generous assistance of Civil Aviation Administration of the Air Department which has enabled particular features under special conditions to be observed and air photographs taken.

INDUSTRIAL AND ROUTINE PROJECTS

Radioactive Minerals—The regional geological work in the Buller Gorge uranium province has been completed. Some detailed mineralogical work continues. Prospecting operations are in the hands of private groups and the last year has seen extensive prospecting work completed by the United Kingdom Atomic Energy Authority.

Foundation Projects—Investigation of dam sites still remains one of the most important sections of applied geology. The principal areas of work have been the Rangitaiki River, Motu River, and Tongariro River project in the North Island, and the Benmore-Lake Tekapo area on the Waitaki River catchment in the South Island. This last area has called for geological investigation not only of the Benmore project itself but of several subsidiary projects in the Mackenzie Basin.

Coal—Day to day advice and consultations continue, particularly in the Greymouth field where prospecting for further areas of mineable coal is claiming increasing attention.

Ground Water—Here again there are frequent calls for advice from the Geological Survey and many of these questions are now answered directly from an examination of maps. It is proposed to issue reports and maps of critical areas from which the users and drillers can make their own decisions.

Geothermal—Geological work in the geothermal area continues to be largely petrological. Examination of bore cores for hydrothermal alteration and hydrothermal minerals related to the search for steam is a continuing project. Geological mapping of the area as a whole has been completed and publication is in sight.

Bauxite—Following the discovery by Soil Bureau officers that certain clays in North Auckland contain a large percentage of gibbsite and bauxite, preliminary drilling as a joint project with Soil Bureau has been completed.

Mineralogy—Mineralogical examination of economic minerals from north-west Nelson and elsewhere continues. Such studies together with structural geology have been made on certain areas and will be published.

Miscellaneous Minerals—Miscellaneous metallic and non-metallic minerals have been identified and commented on from time to time. There is throughout the year a steady flow of such material, very little of which involves additional field work. Certain minerals, particularly barite in north-west Nelson and manganese in various parts of the North Island, have called for examinations both in the field and in the laboratory.

PUBLICATIONS

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Review by N. de B. Hornibrook. *N.Z. J. Geol. Geophys.* 3 (1):105-106.
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- The Geology and Hydrology of Western Samoa. *N.Z. geol. Surv. Bull.* n.s. 63. 1959. D. Kear and B. L. Wood.
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NEW ZEALAND OCEANOGRAPHIC INSTITUTE

Director: Mr J. W. BRODIE

REGIONAL PROJECTS

Physical Oceanography

Hydrology—A preliminary cruise was made to the north and east of New Zealand to investigate the subtropical circulation system. Analysis of sub-antarctic and southern New Zealand circulation has been completed and prepared for publication, and a preliminary analysis of ocean circulation in the New Zealand region is in press. Results of general investigations of surface currents in New Zealand coastal waters and of studies of currents in Hawke Bay and Cook Strait are also in press. A study of the Subtropical Convergence in New Zealand waters was concluded and published.

Deep Currents—An analysis of deep-ocean currents in the Southern Hemisphere based on ^{14}C activity measurements has been concluded and published. A standard ^{14}C reference station has been established 150 miles east of Wellington. This is being reoccupied at six-monthly intervals to keep trace of progressive changes in the ^{14}C activity of surface and deep-ocean currents.

Marine Biology

Plankton—Field investigations of plankton microdistribution have been continued. Four papers published during the year and two in preparation will terminate the present phase of this work. A pilot experiment to study rates of primary organic production by phytoplankton was carried out at Waitarere Beach and results are in press; production was found to be unusually high and further work is planned. The fine structure of diatom cell walls has been investigated in collaboration with Dominion Physical Laboratory electron microscopists and results are being prepared for publication. Seasonal studies on New Zealand phytoplankton have been published. A general account of phytoplankton in New Zealand coastal waters is in preparation. Papers on the systematics and distribution of pelagic amphipods north of New Zealand and in the Antarctic are in press.

Benthic Faunas—The benthic survey of the New Zealand shelf has been expanded with collections in areas along the west coast of the North Island from Kaipara to Cape Farewell. Further investigations were made in Cook Strait. Identification of material collected and correlation of results continue. Work on the systematics of amphipods and isopods and a bibliography of the amphipods continues.

Microbiology—Investigations on the ecology of marine bacteria in different marine environments are continuing. A substantial culture collection has been built up and physiological studies of these isolates are in progress. A new isolation medium derived from marine muds has been developed and has proved more satisfactory than conventional media for use at sea.

Marine Geology

Sedimentation—A systematic sampling of the shelf sediments around New Zealand has been commenced. The first sector sampled has been the west coast of the North Island from Kaipara to Wanganui. Coring and grab samples were taken on lines from shore to shelf edge at 20 mile intervals with stations 1 to 10 miles apart. Mechanical analyses of Hawke Bay sediments and studies of critical clay mineral and ^{14}C analyses are in progress. Detailed studies of Milford Sound sediments have been made. Examination of Foraminifera from sediment samples is in progress. Micro-structures in Hawke Bay and Milford sediments have been examined, and an account of a dyestaining method for studying micro-structures in cores is in press.

Bathymetry—Investigations on the general bathymetry around New Zealand have been concluded and are being prepared for publication. An account of the bathymetry of the east coast has been written and charts are in preparation.

Antarctic Activities

Currents and Tides—Tidal recordings from the gauge installed at Scott Base have been continued. Electrode pairs for current measurements have been installed in McMurdo Sound.

Oceanographic Survey—A more detailed survey of plankton, bottom fauna, hydrology, and sediments has been carried out in two regions—over Pennell Bank and in McMurdo Sound—extending and amplifying the work carried out last season. Three ^{14}C stations were successfully completed. Mutually profitable relations with the Oceanographic Branch of the United States Navy Hydrographic Office have continued. Once again, the bulk of the work has been made possible by generous assistance from the Royal New Zealand Navy in providing ships and time at sea.

SPECIAL PROJECTS

Natural ^{14}C Uptake in Marine Organisms—In collaboration with the Department's Institute of Nuclear Sciences, previous work on ^{14}C content of molluscs has been continued to investigate the biological processes involved. Diving operations have been carried out at Makara to determine the feeding habits of paua, and samples of paua and seaweed taken for comparison of ^{14}C activity with that of sea water from the same area.

Milford Sound—Reports of an oceanographic investigation of Milford Sound have been completed and are being compiled for publication. Included are accounts of the bathymetry, hydrology, bottom fauna, phytoplankton, and bacterial populations, and characteristics of the sediments.

Wave Measurements—Wave recording at Lyttelton Harbour has been completed and the recorder was withdrawn early in the year.

IGY and IGC Analyses—Tidal records from IGY stations have been analysed. Further temperature and salinity stations have been occupied for assessing changes in sea level.

Titahi Bay Survey—Fluorescein dye and floats have been used to measure surface-water circulation in an investigation in the Titahi Bay region in collaboration with the Ministry of Works. A report on the results is in preparation. A tide gauge has also been installed.

East Clive Beach—Tidal stream investigations are being carried out in this region using fluorescein dye, drift cards, and aerial photography, and results will be made available to the Hastings City Council in connection with planned sewage outfalls. In this and other studies on surface-water movement the assistance of the Royal New Zealand Air Force in the provision of dyes and markers is gratefully acknowledged.

Cook Strait Cable—Observations of tidal currents and collection of sediment samples has continued. Tracer experiments with artificial sediments to determine movement by bottom currents have been written up.

Foveaux Strait—A survey of the hydrology, biology, and sediments of Foveaux Strait has been planned in conjunction with more detailed work on an oyster-bed survey by the Marine Department. Temperature recorders are being installed to measure seasonal changes and seasonal salinity observations will be made. Analyses of existing sediment collections from the area have been commenced and background data on biology and hydrology accumulated.

Macquarie Ridge Survey—A proposed survey of the benthic fauna to be carried out from HMNZS *Endeavour* along the Macquarie Ridge, to investigate faunal connections between Antarctica and New Zealand and the hydrology of the deep channel between this ridge and the Campbell Plateau, was hindered by bad weather, but a widely-spaced programme of sampling was carried out on the Campbell Plateau and around Auckland and Campbell Islands.

Facilities

New sea-going arrangements have resulted in satisfactory completion of a full programme of oceanographic observations this year. Additionally the Navy Department has given valuable assistance by providing vessels for three major cruises.

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- An Oceanographic Survey of the Ross Sea. *Nature* 184:422-3. J. S. Bullivant.
- Some Photographs of the Bottom Fauna in the Ross Sea. *N.Z. J. Sci.* 2 (4):485-97. J. S. Bullivant.
- Stomach Contents of Spawning Quinns Salmon. *Nature* 184:71. J. S. Bullivant.
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- A Section of ^{14}C Activities of Sea Water between 9°S and 66°S in the South-west Pacific Ocean. *N.Z. J. Geol. Geophys.* 2 (4):799-824. R. W. Burling and D. M. Garner.
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- Some Correlations in Replicate Plankton Samples. *Ibid.* 2 (4):473-84. R. M. Cassie.
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- Studies on Australian and New Zealand Diatoms III—Descriptions of Further Discoid Species. *Trans. roy. Soc. N.Z.* 87 (3 & 4):211-9. E. J. F. Wood, L. H. Crosby, and Vivienne Cassie.
- An Interpretation of the Molluscan Genus *Amphidesma* in New Zealand. *Aust. J. Malacology* 8:39-58. E. W. Dawson.
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- Notes on the Ecology and Environmental Adaptations of the Terrestrial Amphipoda. *Pacific Science* 13 (2):101-29. D. E. Hurley.
- Contributions to Marine Microbiology. *N.Z. Dep. sci. industr. Res. Inf. Ser.* 22. (*N.Z. Oceanog. Inst. Mem.* 3) 67 pp. Comp. T. M. Skerman.
- Some Methods of Obtaining Large Samples of Sea Water from Depth. *N.Z. J. Sci.* 2 (3):393-7. R. P. Willis.

PLANT CHEMISTRY DIVISION

, Director: Dr A. T. JOHNS

PROJECTS

Bloat in Cattle—An investigation of animal and plant factors involved is being undertaken, e.g., eructation mechanism, composition of bovine saliva, nutrition of rumen protozoa, metabolism of fat, release of soluble constituents from plant material by chewing, anti-foaming properties of plant fats, and plant carbohydrates and their fermentation products in the rumen.

Plant Biochemistry and Organic Chemistry—A number of compounds in ryegrass and clover are being identified and their mode of biosynthesis investigated. These are being studied both for their interest in plant biochemistry and from their role in animal nutrition, e.g., the compounds formed by the fixation of nitrogen in clover-root nodules, assimilation of urea by plants, allantoin biosynthesis, plant amines—ethanolamine, cyanide-containing glucosides, perloline, antifungal, and oestrogenic substances in red clover, and a determination of the organic acids in plants.

Proteins and Nucleic Acids—The study of plant ribonucleoproteins is continuing using embryonic tissue such as germinating peas or wheat germ. The aim is to isolate the various large subunits which together constitute the microsomal ribonucleoprotein particle, the "ribosome", which is considered to be the site of protein synthesis in the cell. Work on the isolation of deoxyribonucleic acid (DNA) of plant tissues has commenced. Plant DNA contains a higher proportion of 3-methyl cytosine than does animal DNA, and it is hoped to learn something of the distribution of this base, and of its mode of introduction into the DNA molecule. The characterisation of protein from ruminant saliva is continuing. In conjunction with Plant Diseases Division a study is being made of the properties of several plant viruses.

Ryegrass Trial—A trial is being conducted in conjunction with the sheep husbandry department of Massey Agricultural College on the relative merits of short-rotation and perennial ryegrass, both with and without clover, in animal nutrition. Factors being studied include iodine nutrition of sheep as affected by possible goitrogenic principles and low iodine status of some grass species, incidence of facial eczema, hogger ill-thrift, and rickets. Work in collaboration with Dominion Laboratory is in progress to identify unknown non-protein nitrogen compounds in ryegrass at flush periods of growth.

Carbohydrate Chemistry—Investigation of carbohydrates of clovers and grasses and bacterial polysaccharides in the rumen.

Lipids—Studies on the role of rumen bacteria and protozoa in the hydrogenation of plant fat.

Facial Eczema—A study is being made of the structure and mode of synthesis of the "beaker test" substance by *Pithomyces chartarum* (synonymous with *Sporidesmium bakeri*). The conditions leading to build-up of the fungus under field conditions are being investigated.

Microbiological Work—The isolation and culture of rumen bacteria and protozoa and a study of their nutrition and metabolism.

Investigation of patterns of effectiveness of clover rhizobia is being undertaken together with the estimation of numbers of rhizobia present in various soils. The treatment necessary for good clover growth at Kaikohe substation is being investigated.

Mineral Nutrition—Mineral analyses of plant material are being carried out. Differences in the ability of pasture plants to accumulate trace elements is being investigated in conjunction with Grasslands Division, Soil Bureau, and Rukuhia Soil Research Station.

Ruminant Physiology—The study of the mechanical activity of reticulum and rumen, the eructation process, and treatment and prophylaxis of bloat with anti-foaming agents is being continued.

PUBLICATIONS

Bloat in Cattle—

XIII—The Effect of Orally Administered Penicillin on the Fermentation and Foaming Properties of Rumen Contents. *N.Z. J. agric. Res.* 2:342–54. J. L. Mangan, A. T. Johns, and R. W. Bailey.

XIV—The Concentration of Soluble Polysaccharides in the Rumen Contents of Cows Fed on Red Clover. *Ibid.* 2:355–64. R. W. Bailey.

XV—Further Observations Concerning the Ciliate *Epidinium ecaudatum*, an Inhabitant of the Rumen of Cows Liable to Legume Bloat. *Ibid.* 2:365–74. A. E. Oxford.

XVI—Bovine Saliva: The Chemical Composition of the Parotid, Submaxillary, and Residual Secretions. *Ibid.* 2:990–1001. A. T. Phillipson and J. L. Mangan.

XVII—A Technique for Recording Pressure Changes in the Reticulo-rumen of Cattle, Using Small Electrical Pressure Transducers and a Four-Channel Recorder. *Ibid.* 3:41–62. C. S. W. Reid, A. W. Melville, and J. B. Cornwall.

XVIII—The Proteins of Bovine Saliva. *Ibid.* 3:63–68. J. W. Lyttleton.

The Nature of the Polysaccharides of the Dextran-producing Organisms *Leuconostoc mesenteroides*, *L. dextranicum*, and *Streptococcus bovis*. *J. gen. Microbiol.* 20:258–66. R. W. Bailey and A. E. Oxford.

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- The Metabolism of Carbon Dioxide by *Streptococcus bovis*. *J. gen. Microbiol.* 22:714-26. D. E. Wright.
- The Treatment and Prevention of Bloat with Anti-foaming Agents. *Proc. Nutr. Soc.* 18:127-30. C. S. W. Reid.
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PLANT DISEASES DIVISION

Director: Dr E. E. CHAMBERLAIN

PROJECTS

Entomology—General: Investigation of the field ecology of the cabbage aphid (*Brevicoryne brassicae*) in Canterbury (with Entomology Division); host resistance to *B. brassicae* in brassica field crops; biology of San Jose scale; survey of scale insects on apples in New Zealand; investigation of the occurrence and life history of the Argentine stem weevil (*Hyperodes griseus*) in the Mangere district; life history and distribution of Chironomid midges breeding on the Auckland Metropolitan Drainage Board reclamation area; life-history studies of the giant wetas (*Deinacrida fallai* and *D. heteracantha*); life history and behaviour of the New Zealand glow worm (*Arachnocampa luminosa*) with special reference to cave-dwelling forms; and systematic studies on Orthoptera, Trichoptera, Lepidoptera, and cave insects.

Insecticides: Control of existing infestations of *Anobium punctatum*; hormonal evocation of moulting and excretion in *Rhodnius prolixus*; nature and potency of a mite toxin; and ionic balance following DDT poisoning.

Economic Mycology—Studies on physiological races of and varietal resistance to French-bean rust, bean anthracnose, and *Verticillium* wilt (cooperative projects with Crop Research Division); determination of host range of *Verticillium* wilt; investigations on the elimination of onion white rot from the soil by methyl bromide fumigation; studies on prevention of silver leaf of stone fruits by treatment of pruning cuts; investigation of the cause of rose die-back; studies on tomato leaf mould including testing of varieties for resistance, improvement of the variety V548 by selection and raising and testing of mother seed of V548 (co-operative project with Crop Research Division); investigation of the association of nematodes with strawberry black root rot and kumara tuber splitting; studies on soil and seed transmission and control of *Didymella* stem rot of tomatoes by spray applications (in cooperation with Horticulture Division, Department of Agriculture); and testing of intermediate vigour apple rootstocks for resistance to *Phytophthora* root rot.

Investigations on death of pine trees: Association of *Phytophthora* species in the soil with pine tree death; identification and distribution of *Phytophthora* species in forest and shelter-belt soils; and testing pathogenicity of species isolated.

Investigation of the life history and distribution in pastures of *Pithomyces chartarum*, the fungus causing facial eczema in sheep.

Field crop diseases: Control of potato pink rot with fungicides applied to the soil; life history studies of the fungus causing dry rot of brassicas with special reference to the relative importance of infection from seed and from wind-borne ascospores; control of wheat leaf rust with eradicator fungicide sprays; studies on the physiological races of and varietal resistance to wheat stem rust (in cooperation with the University of Sydney); testing of newly developed swede varieties for combined resistance to dry rot, club root, and cauliflower and turnip mosaic (in cooperation with Farm Advisory Division, Department of Agriculture); cereal yellow dwarf—selection and testing of wheat and oat varieties for resistance, studies in control on spring-sown wheat and oats of aphids with systemic insecticides, investigation of inheritance of resistance in wheat and development of a technique for measuring relative susceptibility of varieties; determination of field tolerance of pea varieties grown in New Zealand to pea leaf roll virus (pea yellows virus) and selection within pea varieties for resistance to the virus; studies on control of cauliflower mosaic and carrot motley dwarf viruses by the use of systemic insecticides as seed dressings; and investigations on control of blind seed disease of ryegrass by application of fungicides to infected seed or soil.

Seed pathology: Investigation of seed health tests (in collaboration with the International Seed Testing Association); studies on the comparative efficiency of dusting and slurry treatment of seed for control of seed-borne diseases of cereals, peas, and brassicas; development of a cold test to assist in assessing the efficiency of seed treatments used for control of seed-borne cereal diseases; control of wheat bunt by seed treatment; investigation of the possibility of controlling maize stalk rot by pelleting seeds with fungicides (in cooperation with the Farm Advisory Division, Department of Agriculture); control of onion white rot by pelleting seeds with fungicides and search for a fungicide to give combined control of onion smut and onion white rot; survey of linseed seed crops for seed-borne diseases using the Ulster method; and investigation of the condition known as hollow heart in garden pea seed.

Identification and recording fungi responsible for plant diseases; and maintenance of a list of all plant diseases recorded in New Zealand.

Systematic Mycology—Maintenance and further development of the herbarium of fungi, emphasis being placed on collecting in the Hymenomycetes in the Basidiomycetes, and in the Pyrenomycetes in the Ascomycetes, as well as general collecting in the New Zealand parasitic fungi; special studies in *Fusarium* spp. associated with death of passion-fruit vines and new records of rust fungi in New Zealand; studies in taxonomy and strains of the facial eczema fungus *Pithomyces chartarum* (Berk. & Curt.) M. B. Ellis—as a result of publication by Dr M. B. Ellis (Dematiaceous hyphomycetes, *Mycological Papers*, No. 76, Commonwealth Mycological Institute, Kew, Surrey) the name *Sporidesmium bakeri* Syd. is shown to be synonymous with *Pithomyces chartarum*—; taxonomy of Streptomycetes from New Zealand soils.

Bacteriology—Taxonomic studies of the genus *Xanthomonas*; identification of bacterial species by request from overseas countries; pathogenicity studies with bacterial cultures from overseas countries; investigations on cause and control of a blast disease of tomatoes; studies on control of bacterial spot of plum and peach; investigations on protection of seedlings and cuttings from crown gall; investigation of techniques to determine infection of black rot in crucifer seed; and maintenance of stock collection of plant pathogenic bacteria.

Maintenance of certification scheme for legume seed inoculants; serological typing of *Rhizobium* strains; search for improved strains; investigation of methods of retaining viability of legume cultures on seeds by use of stickers, seed pelleting, etc.; and maintenance of tested *Rhizobium* strains and supply of experimental cultures.

Microbiology—Studies on aspects of the sulphur metabolism of *Pithomyces chartarum*; investigations on the production of phenol from chlorophenoxy acids by plant pathogenic bacteria (in collaboration with Wye College, University of London); studies on occurrence of auxins in crown gall tissue of tomato; investigations on antibacterial compounds in the guttation fluid from peach leaves; investigations on control of microbial contamination of foods and other natural products for local manufacturers; and investigation of spoilage in canned peas.

Plant Viruses and Virus Diseases—In cooperation with Fruit Research Division, identification of virus diseases of pome and stone fruit trees; effect of fruit tree viruses on tree growth, yield, and rootstock-scion compatibility; use of cross protection in testing of trees for virus freedom and protecting trees in the orchard; indexing of budwood trees; elimination of fruit tree viruses by heat treatment; and establishment of virus free mother trees of popular varieties of pip and stone fruits.

Studies on virus diseases of roses; investigation of virus diseases of clovers and peas; investigation of the value of milk treatments in control of tobacco mosaic in tobacco; and investigation of virus diseases of grape vines.

Investigation of early stages in the multiplication of tobacco mosaic virus in tobacco leaves; mechanism of inhibition of plant virus multiplication by purine and pyrimidine analogues; the properties and significance of virus-like nucleoproteins associated with turnip yellow mosaic virus infections; properties of ribonucleic acids from subcellular fractions of plant and animal cells; the role of virus nucleic acid in antibody production in rabbits; and the nature of virus inhibitors present in aphids.

Plant Physiology—Investigation of blotchy ripening disease in glass-house tomatoes, varietal susceptibility, and influence of light and humidity on disease incidence; studies on leaf and fruit-distorting physiological disorders of pip and stone fruit trees (in cooperation with Fruit Research Division).

Plant Therapeutants—Investigations on chemical control of diseases and pests, e.g., testing fungicides less damaging than Bordeaux mixture for control of bitter rot of apples; assessing the efficacy of recently developed fungicides against black spot of apples; use of eradicated fungicides for control of *Nectria* canker of apple trees; testing of newly available fungicides for control of late blight of potatoes and tomatoes;

trials with eradivative and protective fungicides against onion downy mildew; field studies of *Botrytis allii* and *Fusarium oxysporum*, which both cause bulb rot and death of onion seedlings and storage rot, with a view to developing control measures; testing of copper oxychloride and other plant therapeutants mixed into the soil for control of such soil-borne diseases as *Phytophthora* root rot on fruit trees, *Verticillium* wilt on tomatoes, and crown gall on various plants; and comparison of chloropicrin, Vapam, and methyl bromide as pre-replant treatments for old tree sites in cherry cages.

Testing materials for both dormant and summer control of San Jose scale on apple trees; trials with newly developed insecticides against codling moth; investigation of the European red mite problem, including testing of control programmes in the field and laboratory determination of susceptibility and resistance of mite populations to various acaricides; use of *Tetranychus telarius*, the two-spotted mite, as a laboratory test animal to investigate the effect of environment and egg age on susceptibility to ovicides; and laboratory screening of insecticides and investigation of field control of mealy bug on apples and pears.

Servicing—Maintenance of an advisory service to the Department of Agriculture, other Government Departments, and the public on identification and methods of control of plant diseases and pests; to Government Departments and industry on industrial microbiological problems; and for the Quarantine Service of the Department of Agriculture the growing, under strict quarantine conditions, plants introduced under special permit.

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SCIENTIFIC LIAISON SERVICE

Officer in Charge: Mr N. A. MARRIS

ACTIVITIES AND PROJECTS

London—Scientific liaison work in its many facets has increased in quantity and variety during the past year.

The Senior Scientific Liaison Officer has continued to represent New Zealand on a number of Commonwealth and special committees, these include: Commonwealth Advisory Aeronautical Research Council, Commonwealth Advisory Committee on Defence Science, Commonwealth Agricultural Bureaux Executive Council, International Standards Organisation Technical Committees, Board of Governors of Imperial College of Science and Technology, Pest Infestation Board, Pure Food Centenary

Committee of the Society of Chemical Industry, and Council of the Royal Society of Chemistry.

Some of the conferences attended by the Department's Scientific Liaison Officers included the meeting of the British Association, the International Agricultural Aviation Conference, and the annual conference of the Society of Chemical Industry. Reports of these conferences, together with copies of papers presented, have been forwarded to New Zealand. Many other scientific meetings have also been attended and reported on, including the British Society of Soil Science, Royal Society, Society of Chemical Industry, Geological Society, Geologists' Association, Society of Applied Biologists, Institute of Information Scientists, and United Kingdom Parliamentary and Scientific Committee.

As time allowed, advantage was taken of Open Days at Research institutions and scientific and technical exhibitions to obtain information of value to New Zealand, and extend contacts with British scientists and firms. During the past year some of the more important of these visits were British Coal Utilization Research Association, British Iron and Steel Research Association, Glasshouse Crops Research Association, Water Pollution Research Association, Torry Research Station (Aberdeen), and exhibitions such as those of the Physical Society, Industrial Photography and Television, Agricultural Machinery, and Mining Machinery. Visits were also paid to other establishments, including Government Departments, universities, and commercial firms.

Miscellaneous inquiries of many kinds, both from New Zealand and the United Kingdom, continue in large numbers. Some of the subjects dealt with, apart from those dealing with publications, are utilisation of peat, current prices and requirements for ambergris, standards for electric blankets, methods of testing fuses, timber glues, bookbindings, market for lactic acid, and calcium lactate, New Zealand egg pulp, scientific films, briquetting of wood waste, and New Zealand ironsands and other natural resources. A comprehensive account of New Zealand resources, with a summary of New Zealand scientific achievement, was prepared at the request of the Duke of Edinburgh, who sought similar information from other Commonwealth countries.

Scientific visitors from New Zealand, both from within the Department and from other departments and the universities, have made use of the services of the office in many ways. Visits have been arranged for them, contacts made, and information and literature supplied. Besides short-term visitors from New Zealand this office assists and acts on behalf of a number of New Zealand scientists in this country on scholarships and fellowships or on study leave.

The Scientific Liaison Officer has, at the request of New Zealand House, given a large number of talks to various English societies and groups of young people.

The amount of routine work also tends to increase. It includes the processing of orders for radioactive isotopes for New Zealand laboratories; the acquisition and forwarding to New Zealand of the latest scientific publications; trade literature of interest to scientists, and where possible, unpublished reports and papers; obtaining photocopies of articles in scientific journals not available in New Zealand; and interviewing numerous callers inquiring about the possibilities of scientific employment in New Zealand or seeking other information.

Washington—The work of this office has included the accession and distribution of an ever-increasing number of New Zealand and American publications. A large amount of valuable data has been obtained from United States Government and private sources about such subjects as scientific research and development statistics, air pollution, oceanography, scientific manpower, etc. Visiting New Zealand scientists were assisted in their travels and appointments, and samples, films, and testing materials were procured and shipment expedited.

SOIL BUREAU

Director: Mr N. H. TAYLOR

PROJECTS

Soil Survey—Raglan County (2 m./in.); Rangitaiki Plains (40 ch./in.); Kairanga County (40 ch./in.); Paparua County (40 ch./in.); Upper Clutha (40 ch./in.); South Island (4 m./in.); Fiji (2 m./in.); and Taylor Valley, Antarctica.

Soil Chemistry—Potassium-supplying power of soils; residual effects of phosphate topdressing on New Plymouth black loam; survey of available minerals in soils as extracted by sweet vernal-chlorine; improvements in analytical methods—sulphur; analyses of representative profiles as a basis for reappraisal of New Zealand soils; and nutrient cycle in hard beech forest.

Soil Physical Chemistry—Systematic survey of inorganic soil colloids—Antarctic soils, preweathered soils of Nelson, forms of iron and aluminium in soils by magnetic susceptibility, forms of phosphate in topdressed soils; mechanism of ion adsorption; source of radioactivity in New Zealand soils; source of radioactivity in Niue Island soils; application of experimental pedology in the study of soil formation in the brown-grey earths and under kauri; and aluminium in subsurface clays of ironstone and related soils.

Soil Physics—Survey of physical properties of main soil groups—soils from greywacke; pumice and perlite as soil amendments; establishment of texture standards for New Zealand soils; and physico-chemical studies of soils containing amorphous materials.

Soil Biology—Biology and biochemistry of soils under forest and under pasture following forest; microbiology of Antarctic soils; identification in soils of simple organic foods for micro-organisms; soil animals in New Zealand soils; antibiotic relationships of soil micro-organisms; and effect of pH on availability of plant nutrients in New Zealand soils, using ryegrass (*Lolium perenne*).

Soil Engineering—Corrosion of mild steel, concrete, and cement asbestos in soils; significance of triaxial tests on dry clay; strength of a soil at the liquid limit; measurements of earth pressure on sheet piling for Auckland Harbour Board; development of sensitivity in soils by reducing processes; self-recording consolidation tests; effect of rate of loading on the consolidation of soils; and development of sampler for collecting samples of undisturbed soil.

Extended Projects Undertaken Jointly with Other Organisations—Correlation of land-use data with soils on extended legend of South Island general survey; water and mineral balances in Taita native catchment—hydrology and chlorine balance; chlorosis of cypress at Golden Downs State forest; effect of grazing animals on potash status of soils; effect of stock treading on pasture soils; soil and leaf micro-organisms in relation to ryegrass staggers in sheep; studies in *Pithomyces chartarum* (synonymous with *Sporidesmium bakeri*)—spore-counting and culture of material for other research organisations, production of toxin in synthetic media; and relation between dental caries and soil type—comparison of conditions at Napier and Hastings.

PUBLICATIONS

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- Yeasts from the Leaves of Pasture Plants. *N.Z. J. agric. Res.* 2:394–405. M. di Menna.
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- The Soils of Otago and their Problems. *N.Z. Grasslands Conf. Proc.* 20:27–40. J. D. Raeside and E. J. B. Cutler.
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- Biological and Chemical Changes Following Scrub Burning on a N.Z. Hill Soil. II. Changes in soil pH. *N.Z. J. Sci.* 2:171–181. R. B. Miller and M. Fitzpatrick.
- Effect of Phosphate Top Dressing in a Soil from Andesitic Volcanic Ash—
 I—Forms of Soil Phosphorus and a Method for their Determination.
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- The Association of *Phytophthora* Sp. with Mortality of *Pinus radiata* and other conifers. Part 2. *N.Z. J. agric. Res.* 2:844–858. C. F. Sutherland, F. J. Newhook, and J. Levy.
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- Bauxite in the Red-brown Loam Soils of New Zealand: *Proc. of a Mineral Conference, Otago School of Mines, 1959. Paper No. 184.* L. D. Swindale.
- Some Limiting Factors in N.Z. Soils. *N.Z. Soil Sci. Soc. Proc.* 3:3-10 J. K. Dixon.
- Symposium on the Waikato Basin (Soils of the Waikato Basin). *Ibid.* 3:27-29. N. H. Taylor and I. J. Pohlen.
- Reactions of Amorphous Soil Colloids with Ions in Solution. *Ibid.* 3:1-13. K. S. Birrell.
- An Improved Apparatus for Filtering Solutions for Flame Photometry Analysis. *Chemist Analyst* 48:82-83. L. C. Blakemore and M. Fitzpatrick.
- Soils and Agriculture of Part Geraldine County, New Zealand. *N.Z. Soil Bur. Bull.* 13. 65 pp. J. D. Raeside, M. Cameron, and R. B. Miller.
- Fate of Potassium Applied to Pasture on a Soil Derived from Andesitic Ash. *N.Z. J. agric. Res.* 2:1211-1231. W. M. H. Saunders and A. J. Metson.
- Soil Classification for the User. *N.Z. Instit. of Agric. Sci. Proc.* 33-38. H. S. Gibbs.
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- Stability of Index Minerals in Soils with Particular Reference to Quartz, Zircon, and Garnet. *J. of Sed. Petrol.* 29 (4):493-502. J. D. Raeside.
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TOBACCO RESEARCH STATION

Director: Mr R. THOMSON

PROJECTS

Seedling Bed Work

Alternatives to steam sterilisation for the control of weeds and disease: control of bed rots (*sclerotinia* and *botrytis*) by the use of fungicides; testing the compatibility of various fungicides and insecticides for use on tobacco seedlings; and alternative materials for seedling bed covers.

The Crop in the Field

Fertilisers—Response of tobacco to minor elements, copper, manganese, zinc, molybdenum; effect of irrigation on fertiliser requirements; varietal response to fertilisers; and demonstration plots to illustrate various deficiencies.

Cultural—Effect of spacing plants on total yield and quality of leaf, two varieties; cultivation practices in relation to yield of leaf and spread of mosaic; irrigation studies on the water requirements of the tobacco crop; and control of weeds by the use of chemical weedkillers and the effect of such chemicals on the tobacco crop.

Cover Crops—Fertiliser requirements of cover crops; testing various cover crops; and trial of growing tobacco with alternate grass strips.

Variety Trials—Testing of new overseas and locally developed varieties.

Plant Breeding—Breeding for resistance to black root rot, mosaic, verticillium wilt, and *Phytophthora* canker; and studies of inheritance.

Seed Production—Testing of locally raised lines against originally imported seed; production of nucleus lines of progeny tested seed; and maintenance of a supply of seed for the industry.

Kilns and Curing—Study of the condition known as “chilling”; investigation into alternative methods of handling leaf in the kiln; investigation of faults in curing; and technical advice on kiln design and management.

Diseases—Control of verticillium wilt by soil treatment; development of methods of applying fungicides on a field scale; use of fungicides to control *sclerotinia* and *botrytis* in the field; effect of skim milk on the spread of mosaic; and study of kiln conditions conducive to mould development.

PUBLICATIONS

Verticillium Wilt of Tobacco. I. A New Disease Caused by *Verticillium dahliae* Kleb. *N.Z. J. agric. Res.* 2:785-791. R. Thomson and A. G. McLeod.

Verticillium Wilt of Tobacco. II. Field and Glasshouse Trials to Determine Resistance of Varieties and Species to *Verticillium dahliae* Kleb. *Ibid.* 2:792-796. A. G. McLeod and R. Thomson.

WHEAT RESEARCH INSTITUTE

Director: Mr E. W. HULLETT

Services—Experimental determination of the milling and baking qualities of new wheats produced at the Crop Research Division; routine wheat and flour testing for millers, bakers, and the Wheat Committee; and technical advisory service for millers, bakers, and other flour users.

Projects—Development of rapid quality tests to facilitate the best utilisation of New Zealand wheat crops; study of theoretical and practical significance of new continuous breadmaking processes and their impact on wheat-breeding objectives; wheat proteins in relation to dough structure and the action of maturing agents; dough ripening process and causes of grey crumb colour in bread; production control in mechanised bakeries; and steam efficiency of bakers' ovens.

PUBLICATIONS

Puff Pastry - Fundamentals of Manufacture. *N.Z. Baker*. March 1959. J. Nolan.

Puff Pastry - Recipes and Fillings. *Ibid.* April 1959. J. Nolan.

Short Pastry - Theory and Practice. *Ibid.* May 1959. J. Nolan.

Varieties of Shortbread and Short Pastry Goods. *Ibid.* June 1959. J. Nolan.

Further Short Pastry and Shortbread Recipes. *Ibid.* July 1959. J. Nolan.

High Ratio Cakes - Introduction and some Formulae and Icings. *Ibid.* August 1959. J. Nolan.

High Ratio Fruit Cakes. *Ibid.* November 1959. J. Nolan and R. W. Cawley.

High Ratio Cake - Formula Balance. *Ibid.* December 1959. J. Nolan and R. W. Cawley.

The Significance of Moisture in Wheat. *Proc. 9th Lincoln College Farmers' Conf.*: 115-121. 1959. E. W. Hullett.

INCORPORATED RESEARCH ASSOCIATIONS

NEW ZEALAND LEATHER AND SHOE RESEARCH ASSOCIATION (INC.)

Director: Mr F. W. WOODROFFE

The use of boric acid and naphthalene in the curing salt has been further developed and has proved to be very satisfactory. It gives a well-coloured hide, free from stains, either of bacterial origin or due to held blood, whilst volatile nitrogen figures confirm the good preservation of the collagen. This work has been widely applied throughout the industry, and more so as a result of the Association extending its membership to include hide processors who also are directly interested. The reuse of the curing salt has also been investigated and it has been found that the New Zealand salt is particularly good, both in regard to the preservation of the hides and the amount of hides that can be treated.

The filling of chrome-tanned calf and side leathers in order to give increased substance and less waste in the flanks has had continued attention. Whilst synthetic resins have been used successfully by members, there is the risk of surface deposition unless the preliminary neutralising is properly carried out. Trials have been carried out using zirconium salts after the chrome tannage to get the desired filling. These trials are still proceeding.

Vulcanised sole attachment, whereby the rubber dough is vulcanised to the shoe upper under pressure in a heated mould has brought many problems for the tanner. A welting leather has had to be prepared which would withstand these high temperatures without deterioration; also, upper leathers with the desired physical properties to withstand the process had to be produced. Preliminary specifications, to which members are being asked to conform, have been established.

Extensive testings of locally-made synthetic solings for footwear members have been carried out and, again, specifications have been laid down by which the probable performance in use can be forecast. These soling materials have also called for considerable work on adhesives, as, because of varying formulations, the usual adhesives have often been ineffective.

Large-scale trials have been carried out with re-designed Army boots. Four types have been under test and the boots have now been returned for destructive analysis. A new range will shortly be ready for further trial.

PROJECTS

The use of boric acid and naphthalene as additives to curing salt; the use of low alkali paints in fellmongering; the use of drums in place of paddles in the liming of sheep and lamb pelts; temperature control of liming process; the investigation of chrome zirconium tannages – (a) for white leather, (b) as a filling agent; the use of highly polar compounds for fatliquoring; and the production of aniline and semi-aniline calf and side leathers.

RESEARCH INSTITUTE OF LAUNDERERS, DRYCLEANERS AND DYERS OF N.Z. (INC.)

Director: Mr N. S. WHITTALL

Washing Trials—Extended washing trials have been continued in an effort to correlate the degree of degradation with conditions of use and methods of laundering. The results show that, up to about 25 washes, the degree of degradation in fabric strength and colour is independent of use and the wash process. After that, there is a marked difference in the rate of degradation depending on the use to which the fabric is subjected and the wash process used. The results from these trials, although not fully complete, have led to recommendations in respect of control and modification of wash processes.

Continual investigations are being made into the problems associated with the use of optical white dyestuffs. These products are now widely used to give white fabrics a special "fluorescent white" finish. Because of their nature, many of them are unstable to sunlight, perspiration, and acid fumes and serious discoloration results from this instability. The work carried out has been aimed mainly at removal of the dyestuff without degradation of the fabric.

Metallic Staining—The presence of minute quantities of iron and other metallic salts in both laundry supplies and drycleaning plants is the cause of considerable staining and discoloration in fabrics. Shrink-resistant woollens, for instance, exhibit a tendency to preferentially retain iron from solutions, with resultant serious discoloration. As such woollen goods are coming more into use, particularly as hospital blankets, the problem of overcoming this staining has become of increasing importance. Investigations have been carried out with a view to incorporating chemicals into the cleaning systems, which will prevent the iron reacting with the fabric and yet not interfere with the other chemicals used. No satisfactory answer to the problem has yet been found and work is continuing. Investigations into causes of damage and staining of clothing during wear, drycleaning, or laundering continue and show a substantial increase over the preceding years.

General—The services of the Institute are now available to fabric importers and garment manufacturers, and the textile-testing services were widely used by this group of members.

Various technical conferences have been held, both at the laboratory and in the main centres. As well as these, visits to plants have been carried out on a routine basis.

During the year a total of 13 technical bulletins has been issued.

THE DAIRY RESEARCH INSTITUTE (N.Z.)

Director Dr H. R. WHITEHEAD

The financial year of the Institute ends on 31 July next, after which a separate report will be issued. The investigations under way include studies of the following subjects.

PROJECTS

Cheesemaking—Changes in the bacterial flora of cheese during the ripening process and investigation of the effect of various bacteria on the

development of flavour in cheese; attempts to isolate and identify the flavouring substances in Cheddar cheese and to determine their origin and mode of formation; investigation of the metabolism of the lactobacilli; the effect of modifications in cheese manufacture on the physical characteristics of cheese with a view to the ultimate mechanisation of the cheesemaking process; factors influencing the incidence of discoloration in cheese; and properties of different wrapping materials for the packaging of rindless cheese.

Buttermaking—Flavour and keeping quality of starter butter manufactured by different procedures; physical properties of butter as affected by temperature treatment of cream; acidity in relation to keeping quality of salted and unsalted butter; manufacture and keeping quality of unsalted starter butter; salt particle size in relation to incidence of spotted colour in butter; cause of development of faults in physical properties of butter during reworking; development of practicable methods for temperature treatment of cream for control of physical properties of butter; and effect of holding of milk at low temperatures prior to separation on quality and keeping quality of resultant butter.

Casein and Other Dried Products—Development of plant for the production and control of casein curd by both batch and continuous methods; study of conditions affecting high capacity sifting rates for ground casein; recovery of casein fines from whey; factors controlling solubility and viscosity of casein; methods of estimating solubility of casein; manufacture of sulphuric-acid casein; use of sulphuric-acid casein whey for feeding of pigs; production of cheese powder; production of whey powders; production of sodium-caseinate; and development of equipment for increased-capacity operation of existing spray drying plant.

Dairy Husbandry—The effect of stage of maturity of grasses consumed by cows and irrigation of pasture on properties and vitamin A content of butterfat.

Farm Milk Cooling and Collection—Development and field trials of a refrigerated holding system.

Factory Steam Supplies—Development of coal handling and measurement equipment for small boilers; and trials of packaged boilers.

Engineering Advisory and Service Section—Detailed advisory work on boiler installations and steam supplies; and testing of dairy machinery.

PUBLICATIONS

- Characteristics of a Presumptive *Pediococcus* Occurring in New Zealand Cheddar Cheese *J. Dairy Res.* 25:409. 1958. J. C. Dacre.
- Phospholipids in New Zealand Dairy Products. III. Effect of Storage on the Phospholipids and on the Partition of Phosphorus in Butter. *Ibid.* 25:475. 1958. A. K. R. McDowell.
- Pyruvate Metabolism in *Lactobacillus brevis*. *Biochem. J.* 72:188. 1959. J. R. L. Walker.
- Dairy Wastes: Disposal of Spray Irrigation on Pasture Land. *Dairy Eng.* 75:251. 1958. F. H. McDowall.
- Butterfat/Water Distribution Coefficients in Relation to Efficiency of Cream Deodorization. *Proc. 15th International Dairy Congress* 2:984. 1959. F. H. McDowall.

- Carbon Dioxide in the Body of Cheddar Cheese and its Rate of Diffusion from the Surface. *Ibid.* 2:846. 1959. P. S. Robertson.
- Mechanization and Short-Time Methods in Cheddar-Cheese Manufacture. *Ibid.* 2:832. 1959. H. R. Whitehead and W. L. Harkness.
- Cream Deodorization Equipment for High Intensity Treatment with Low Steam Requirements. *Ibid.* 4:2117. 1959. J. K. Scott.
- The Comparative Effectiveness of Some Farm Milk-Cooling Methods. *Ibid.* 4: 1958. 1959. J. K. Scott.
- The Reaction of Lactose with Anthrone and its Application to the Estimation of Lactose in Casein and Other Dairy Products. *J. Dairy Res.* 26:53. 1959. E. L. Richards.
- Steam Distillation of Taints from Cream. IV. Vapour/Liquid Equilibrium Relationships for Mesityl Oxide and Some α -Diketones as Possible Reference Substances. *Ibid.* 26:24. 1959. F. H. McDowall.
- Steam Distillation of Taints from Cream. V. Vapour/Liquid Equilibrium Relationships for Some α -Diketones in Lactose Solution. *Ibid.* 26:33. 1959. F. H. McDowall.
- Steam Distillation of Taints from Cream. VI. Butterfat/Lactose-Solution Distribution Coefficients of Some Reference Substances. *Ibid.* 26:39. 1959. F. H. McDowall.
- Steam Distillation of Taints from Cream. VII. Butterfat/Water Distribution Coefficients in Relation to Vapour/Liquid Equilibrium Coefficients for Tainting Substances in Cream. *Ibid.* 26:46. 1959. F. H. McDowall.
- Steam Distillation of Taints from Cream. VIII. Effect of Fat Content of Dairy Product on Deodorisation Process. *Ibid.* 26:113. 1959. F. H. McDowall.
- Effects of Ingestion of Paraffins by Ruminants. VI. Ingestion of Heavy Liquid Paraffin by Cows near Parturition in Relation to Milk Yield and Composition and to Fat-Soluble Vitamin Content of the Butterfat during the Early Stages of Lactation. *N.Z. J. agric. Res.* 2:35. 1959. W. A. McGillivray, F. H. McDowall and C. S. W. Reid.
- Bloat in Cattle. XII. The Effect of Orally Administered Penicillin on Body Weight of Lactating Cows, on Milk Production, and on Production and Composition of Fat. *Ibid.* 2: 62. 1959.
- Recent Dairy Research Work in New Zealand Parts I and II. *Dairy Sci. Abstr.* 21:95. 1959. I. L. Campbell and R. M. Dolby.

THE MEAT INDUSTRY RESEARCH INSTITUTE OF NEW ZEALAND (INC.)

Director: Mr. N. H. LAW

The construction of the new laboratories for the Institute at Hamilton is making excellent progress. As far as can be estimated at this stage the contract date for completion in September 1960, will be met.

PROJECTS

Muscular Contraction—The "relaxation factor" which causes a lengthening and swelling of muscle fibres on addition of adenosine triphosphate (ATP), has now been concentrated about 100- or 200-fold relative to its level in fresh muscle. Despite the appreciable purification

thus achieved, however, the concentrate still contains 8-10 components, not all of which have yet been identified, and paper chromatography and ion exchange techniques are now being used to determine which of these is the active material. To date, factor activity has been detected by means of a "centrifuge test" in which ATP causes an overall fibre swelling in presence of factor or a shrinkage in absence of factor. This, however, requires so much of the factor concentrate that little remains for further chromatography and testing. Attempts are now being made, therefore, to detect factor activity by the microscopic observation of length changes in short pieces of single muscle fibres; this reduces the amount of factor required to about one-fifth of that used in the centrifuge test.

Structural and Enzymic Aspects of Muscle

Aging, Tenderness, and Contraction State in Beef—Studies previously reported on proteolysis in the aging of beef have been completed. It was concluded that the negligible degree of proteolysis observed during the optimum conditioning period is insufficient to account for the considerable softening of the tissue, the reasons for which must be sought elsewhere.

Work on the relation between state of contraction and tenderness in beef has been completed. On the practical side it has shown that contraction causes an increase in toughness, where connective tissue is not a limiting factor. It would, therefore, be most undesirable to remove meat from the skeleton while hot, since contraction occurs with the onset of *rigor mortis*. On the fundamental side, four distinct phases in the contraction pattern sequence of muscle have been observed. The two intermediate forms do not appear to have been previously recognised. It seems that current theories of the mechanism of muscular contraction will need modification to accommodate these forms.

Sub-unit of Myosin—Kominz recently dissociated from myosin, at high pH, a "carbonate sub-unit". The yield, properties, and end-groups of this material indicate its identity with the "D-fraction" which survives the heat coagulation of myosin. Kominz claimed homogeneity for this material on the basis of sedimentation alone. The "D-fraction" also appears homogeneous by this test. "Carbonate sub-unit" has been prepared in this laboratory and found to be monodisperse in the ultracentrifuge, but on electrophoresis gives the three-peaked pattern characteristic of the "D-fraction". This confirms the identity of the two materials.

Adenylic Acid Deaminase in Beef—The enzyme, adenylic acid deaminase is present in quantity in muscle and from tracer experiments is known to function in active muscle. Experiments are in progress to determine the distribution of the enzyme in the muscle cell. Pre-*rigor* muscle blended in sucrose to minimise particle damage, liberates most of the enzyme to the supernatant, from which it is not removed at 27,000 G. It cannot therefore belong to the large granules. On blending *rigor* muscle nearly all the activity remains in the myofibrils and can be extracted with myosin solvents. These preliminary experiments suggest that the association of the enzyme with purified myosin may be an artefact.

Studies of Nucleotide Metabolism in Muscle—An enzyme has been found in muscle which catalyses the condensation of inosine monophosphate and aspartic acid to adenylosuccinic acid. A second enzyme which converts adenylosuccinic acid to adenosine monophosphate and fumaric acid and which appears to be associated with the granular fraction of muscle has been discovered. Adenosine monophosphate formed from this latter enzymic reaction, in the presence of a glycolysing system, is converted to adenosine triphosphate, representing the final step in the enzyme system which synthesises adenosine triphosphate from inosine monophosphate.

The enzyme responsible for the synthesis of adenylosuccinic acid has been partially purified and some of its properties studied. The enzyme is optimally active at pH 6·8–7·0. Inorganic phosphate is partially inhibitory. Guanosine triphosphate which is bound strongly to the enzyme supplies the necessary free energy by its own hydrolysis for the reaction to proceed.

With the identification of these two enzymes involved in the nucleotide metabolism of muscle, the complete cycle of reactions associated with the breakdown of adenosine triphosphate during the process of muscular contraction, to inosine monophosphate and followed by the resynthesis of adenosine triphosphate from inosine monophosphate, has been established.

A method of quantitatively separating and estimating the nucleoside phosphate esters of adenine, inosine, and guanosine on DEAE-cellulose anion exchanger has been developed so that the stoichiometry of the enzymic reaction involved in the formation of adenylosuccinic acid can be determined.

Salmonella—The survey of *Salmonella* infection in stock has been continued. Since this investigation was commenced more than 7,000 samples have been examined. Of these, approximately 5 per cent were found to contain *Salmonella*, mainly *S. Typhimurium*, although a few isolations of *S. bovis morbificans*, *S. senftenberg*, *S. newington*, *S. derby*, and *S. anatum* have been made. As in 1958, the proportion of infected calves reached a maximum during March and April 1959 with a second, though smaller peak in September.

From the results obtained so far it appears that the principal source of the infection in calves is on the farm. This view is supported by the finding that the incidence of *Salmonella* infection in cows killed at the works is similar to that in calves.

As it is known that other diseases or metabolic disorders can predispose an animal towards *Salmonella* infection, faeces samples were obtained from a number of sick cows from farms in a few selected areas where the incidence of *Salmonella* infection in calves has been high. About 10 per cent of these samples contained *S. typhimurium*. A number of these infected animals appeared to be suffering from some disease other than *Salmonellosis*.

The effect of freezing, heat, and irradiation on *Salmonella* is being investigated.

The Freezing of Cartoned Meat—Further investigation has been undertaken into theoretical aspects of the freezing process as applied to cartoned meat. The freezing times for a rectangular block can be accounted for, and these results have been applied to the design of equipment.

Automatic Weighing—The study of methods for the weighing of mutton and lambs carcasses automatically has been continued. Various possible systems have been examined and the field narrowed down to schemes which seem commercially practicable. Operating data have been gathered from scales which are in use in the United States working on pigs, and costs of equipment can now be estimated so as to allow assessment for New Zealand conditions.

Steam Survey—A comprehensive steam survey has been carried out at one freezing works. Steam represents quite a substantial cost item so its use and distribution throughout a plant is of considerable significance. A medium sized works with a reasonably broad range of operation was selected and the steam consumption of the various departments measured. A boiler test was carried out simultaneously to complete the picture of the pattern of supply and demand throughout a working week.

Weight losses by Water Migration—Work has begun on the rates of evaporation of water from the surfaces of animal carcasses on a cooling floor. Continuous records are taken of weights, temperatures, and humidities and the results compared with theoretical predictions.

An investigation has been completed into the overall loss in weight due to evaporation from carcasses of thin ewes during cooling and subsequent freezing under normal works practice. Weight losses were found to be larger than allowed for by the current system of deductions from scale weights.

PUBLICATIONS

Synthesis of Adenylosuccinic Acid in Preparations of Mammalian Skeletal Muscle. *Nature* 183:995. 1959. C. L. Davey.

Striation Patterns of Ox Muscle in Rigor Mortis. *J. Biophys and Biochem. Cytol.* 6:419. 1959. R. H. Locker.

Degree of Muscular Contraction as a Factor in Tenderness of Beef. *Food Research* (2) 25:1960. R. H. Locker.

The Mechanics of Freezing Tissue. *Proc. Comb. Conf. N.Z. Dairy Produce Cool Stores Assoc. and Commonwealth Cold Storage Assoc.* 59-69. 1959. N. H. Law.

THE NEW ZEALAND FERTILISER MANUFACTURERS' RESEARCH ASSOCIATION (INC.)

Director: Dr B. W. DOAK

Conference

A two-day technical conference with fertiliser industry personnel and specialists from Government Departments was again held. This proved to be very successful.

Service

An investigation of methods of mixing of insecticides with fertilisers was carried out. As a result of suggestions made, considerable improvement has taken place.

PROJECTS

Acidulation of Rock Phosphate—Studies of the effect of fineness of grinding, acid strength, acid temperature, and acid/rock ratio on rate of conversion and physical condition of final product have continued.

DDT in Fertilisers—Methods of incorporation and stability of DDT. Serpentine was found to adversely affect the stability of DDT in fertiliser mixtures. This appears to be connected with the magnesium content as all magnesium compounds tried have promoted DDT decomposition.

DDT Loss in Soils—As a result of field reports of the failure of normal DDT applications to control grass grub for three years, work has started on the penetration of DDT into the soil and its loss. Laboratory studies have indicated that the decomposition of DDT in some pumice soils can be considerably greater than in other soils.

Long Term Fertiliser Trials—Analysis of soil samples taken annually do not disclose any material difference between the various phosphates used, apart from an increase in exchangeable magnesium where magnesium-containing fertilisers, e.g., serpentine super and fused phosphates, were used. There is so far no indication of increased loss of magnesium in the plots treated with super as compared with controls. A small increase in pasture yield associated with the use of magnesium-containing fertilisers (at equal P_2O_5 applications) appear to be in part due to a marginal magnesium deficiency in the soil and partly to an effect associated with the reversion of water soluble P_2O_5 to a citric soluble form.

Cattle Tick Control—The use of DDT-super and dieldrin-super has resulted in good control of this pest, especially from early spring application.

Sulphur in Rain and Loss by Leaching—Cultivation promotes leaching loss as a result of decomposition of organic matter.

PUBLICATIONS

The Effect of Granule Size on the Efficiency of Granulated Superphosphate Used as a Pasture Topdressing. *N.Z. J. agric. Res.* 2:234–241. 1959. F. B. Muller.

Also reprinted *Bulletin de Documentation*, International Superphosphate Manufacturers' Assn. 26:1–10. 1959.

THE NEW ZEALAND POTTERY AND CERAMICS RESEARCH ASSOCIATION (INC.)

Director: Mr I. C. McDOWALL

Readsorption—Loss of strength or cracking may result from dried clayware being permitted to adsorb moisture from the atmosphere prior to firing, resulting in an unsatisfactory fired product. It has been shown that the effects are due to differential expansion arising from the moisture gradients which develop.

Automatic Stokers—With increasing interest in the preservation of a clean atmosphere and the general trend to mechanisation, traditional hand-firing methods of stoking the high temperature kilns employed in the ceramic industry are being critically examined. An automatic stoker has been designed in the laboratories for burning cheaply mined sub-bituminous coals in an efficient manner. Satisfactory results have been achieved with an industrial kiln fitted with these stokers but further

work must be undertaken to establish the level of maintenance costs and determine whether the units are commercially satisfactory.

Brick-Mortar Bond—Last year's report described the Association's efforts to introduce a proved system of reinforced brick construction. A fundamental approach to the application of brickwork as a structural unit is being made with an examination of the factors affecting the bond between brick and mortar.

PROJECTS

The origin of plastic clays in the Wellington area; rheological properties of clay slips and pastes; determination of specific surface area; heat in kiln foundations; kiln design; drying of ceramic ware; and jointing of sewer pipes.

PUBLICATIONS

Pyroplastic Index and Firing Deformation of Ceramic Bodies. *J. Amer. Ceram. Soc.* 42:525-532. 1959. D. A. Adcock, J. E. Drummond, and I. C. McDowall.

Development of the Autofeed Stoker with Particular Reference to the Ceramic Industry. *Proc. of a Min. Conf., Otago School of Mines, Dunedin, Paper 158*. 1959. I. C. Hope.

The Ceramic Resources of New Zealand. *Ibid. Paper 141*. 1959. I. C. McDowall.

THE NEW ZEALAND WOOL INDUSTRIES RESEARCH INSTITUTE (INC.)

Director: Dr L. F. STORY

Strength of Staples, Fibre Bundles (parallel fibres of equal length), and Tops—This has been investigated in some detail to evaluate the effects of varying fibre length, crimp and diameter, distance between clamps, rate of testing, etc. For wool-fibre bundles it was found that fibre fineness and tensile strength both increased with fibre length. A linear relationship was found between the logarithm of the breaking load and the test length for wool tops, and from this the fibre length could be predicted and the intrinsic fibre strength measured.

Staple strength measurements on samples taken from seven stores during the 1957-58 selling season confirmed an earlier observation of a marked decrease in strength in crossbred wools through the season, while the level at which the majority of staples broke became progressively higher up the staple.

A manufacturing trial is in progress to compare the performance of a series of medium crossbred (48s) wools differing in staple strength. This has shown that staple strength has a marked effect on worsted processing performance up to the stage of tops, sound wools giving a higher tear and a longer and squarer top than tender wools. The level at which a break occurs in tender wools is of some significance, it being least detrimental when it is near the butt.

Grading of New Zealand Wools—Official data on the composition of the wool clip over five seasons have been analysed to see how far the adjective "good" is justifiable in its application to New Zealand wool. The average percentages of the fleece wool graded as "good", "average", and "inferior" were 10, 60, and 30 respectively. The percentages varied

between centres, Dunedin showing 16 per cent of "good", while Auckland and Wanganui produced negligible amounts. These figures show that there is tremendous room for improvement of New Zealand wool.

Thyroxine Trial—Wool Growth—The thyroxine trial has been abandoned as no significant response was obtained in the last two years. However, the control mob for this trial is being maintained and the wool sampled three times a year as usual. The results will eventually give the most comprehensive picture yet obtained of wool growth during the life of the New Zealand Romney crossbred ewe.

Effluent Disposal—An intensive study has been made of the effluents from a scouring works over a period of six weeks. It was found that the polluting power, while high, was considerably lower than the few published figures from overseas, and rather surprisingly fleece wool gave a liquor of higher polluting power than dagwool. To minimise pollution of streams the scouring liquor should be allowed to settle for several hours and then discharged very slowly into a large volume of rinse water so that it is adequately diluted. The sludge that settles out should be removed frequently and transferred either on to land or to sand drying-beds where it drains and dries quite rapidly and with little smell. The sludge has been found to have some manurial value.

Roller Lapping—Terylene and nylon are being tried as roller lapping instead of the usual coarse wool tops which require frequent replacement under the arduous conditions of commission wool scouring.

PROJECTS

Effluent disposal; comparison of detergents and builders in scouring; strength of wool in relation to growth and manufacturing; fibre breakage in processing; trial with half-bred wools; and effect of oil in woollen processing.

PUBLICATIONS

New Zealand 48s Count Romney Crossbred Wool. *N.Z. J. agric. Res.* 2:214–28, 1959. D. A. Ross.

A Wool Improvement Programme. *N.Z. Meat Producer* (3)7:28–9, 1959. D. A. Ross.

The Effects of Iodine and Thyroxine Administration on the Romney Crossbred Ewe. *N.Z. J. agric. Res.* 2:552–74, 1959. B. J. Myers and D. A. Ross.

Problems in Production and Use of Our Wool Must be Solved in New Zealand. *N.Z. J. Agric.* 98:534–6, 1959. D. A. Ross.

A Semi-micro Method of High Accuracy for the Determination of Sulphur in Wool. *J. Text. Inst.* 50:T494–503, 1959. Ballinda J. Myers.

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IV—Effect on the Fleeces. *N.Z. J. agric. Res.* 2:1096–1103, 1959. L. F. Story and D. A. Ross.

V—Effect of Processing. *Ibid.* 2:1104–10, 1959. L. F. Story.

VI—The Rate of Growth of Wool and its Relation to Time of Shearing. *Ibid.* 3:113–124, 1960. L. F. Story and D. A. Ross.

GRANT-AIDED RESEARCH IN OTHER INSTITUTIONS

On p. 11 are shown the annual grants made by the Department to assist research in other institutions.

CANTERBURY AGRICULTURAL COLLEGE

Director and Principal: Dr M. M. BURNS

PROJECTS

Animal Husbandry Department—Studies in sheep production. Border-Romney trial (grades); Border-Romney stud; ram fertility study; intake: bodyweight-productivity relationships; transaminase test for white muscle disease; and creep feeding.

Agricultural Economics—Inter-farm differences in productivity and efficiency; and price and market research with special reference to wool (new project).

Agricultural Engineering—Reaction of mounted ploughs upon tractors; tractor-guiding instrument; hay curing; and agricultural aviation (new project).

Agricultural Zoology—Thrips infestation of cocksfoot seed crops—completed; the ecology of some grain- and seed-eating birds in Canterbury to be discontinued; and an ecological study of the Argentine stem weevil (*Hyperodes griseus*).

Plant Husbandry—Pasture mixtures at Ashley Dene: improvement of *M. glutinosa*; lucerne agronomy studies; physiological studies in lucerne; and special grassland problems (new project).

Horticulture—Tomato-yield trials; miscellaneous plant propagation studies; and evaluation of electrical heating for glasshouses.

Agricultural Microbiology—Microbiology of wool; thermophilic bacteria; soil microbiology; and rhizobium.

Soil Science Department—Studies on organic matter; nutrition of legumes; sulphur studies; lime studies.

Wool Department—Studies in fleece rot; documentation of wool production within a self-maintaining Corriedale flock; prediction of adult fleece from lamb coat; application of progeny test and half-classing methods in Merino ram selection; behaviour of follicle papilla in relation to changes in level of wool production; measurement of moisture in wool by semi-electronic equipment; and fleece establishment in Border Leicester sheep (new project).

PUBLICATIONS

Antibiosis in the Ecology of Soil Organisms. *Proc. N.Z. Soc. Soil Science*, November 1959. I. D. Blair.

Wheat Seed Treatment and Poor Vigour. *N.Z. Wheat Review*:64-70. 1959. H. C. Smith and I. D. Blair.

Loss and Damage in Potatoes. *Tech. Publn. 18 C.A.C.* 1959. I. D. Blair.

- Fungi in Relation to Pasture and Animals. *Proc. Ruakura Farmers' Conference* 1959. I. D. Blair.
- Discoloration of Wool Fibres by a Fungus. *Nature* 183:1281. 1959. A. P. Mulcock.
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- Seed Germination in Wintersweet. *N.Z. Gardener.* (4) 16. 1959. S. Challenger and E. J. Martin.
- Comparison of Glasshouse Heating Costs. *Proc. R.N.Z.I.H. Conf.* 1959. J. H. Glazebrook.
- Studies in Soil Organic Matter. II. *Soil Science* 87:1. 1959. T. W. Walker and A. F. R. Adams.
- Studies on Soil Organic Matter. III. *Ibid.* 87:135. 1959. T. W. Walker and A. F. R. Adams.
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- Reliability of the Compressometer Method for Analysis of Coarse Wools. *N.Z. J. Sci.* 2:379-387. 1959. D. O. Ryde and A. E. Henderson.

CAWTHRON INSTITUTE

Director: Dr C. R. BARNICOAT

The grant-in-aid from the Department of Scientific and Industrial Research has been devoted to investigating the nutrition of fruit, tomatoes, hops, tobacco, and to soil and pasture studies. Collaboration with Hop and Tobacco Research Stations, with Soil Bureau, and with branches of other Government Departments has been maintained.

PROJECTS

Hop Research—Research on the influence of minor elements, sources of nitrogen, and composition of fertiliser on yield and resin content of hop cones in different varieties has been continued.

Studies on the nutrient requirements of the black root-rot fungus (*Phytophthora cactorum* (Schroet)) have been extended to the amino acids.

The hop nursery at Marsden Farm, established last year for propagating disease-resistant strains bred at the Hop Research Station, has functioned satisfactorily.

Tobacco Research—Studies on the influence of certain inorganic nutrients (including minor elements) on the composition of leaf are being continued.

Research on tobacco is now concentrating on the relationship between quality of leaf and chemical composition. To this end, methods are being studied for determining the components of the important nitrogenous and carbohydrate fractions.

Fruit Research—The finding that bitter-pit tends to be present in apples of low calcium content and with high potassium to calcium ratio is being further investigated by means of a series of experiments involving foliar spraying of these and other elements, and extensive chemical analyses of the leaves and fruit. The influence of nutrients on the growth of raspberry canes has also been studied.

Tomato Research—Experiments with trickle irrigation under commercial glasshouse conditions have continued. Trials with minor elements, especially with regard to leaf chlorosis, have not so far yielded significant results. Experiments with varieties, manurial, and hormone treatments are in progress.

In water-culture experiments concerning "cloud" a study has been made of the relative importance of actual concentration ("strength") and relative concentrations ("balance") of minerals in the nutrient solution. Surprisingly, "balance" appears to be the more important which opens up further interesting lines for investigation.

Soils and Pastures—Field trials with pastures have demonstrated the importance of addition of magnesium to pakihi-type soils at Onekaka. Experiments at Eighty-eight Valley are in progress, though delayed by the dry weather.

Further work, both in the field and the laboratory, is required before completing the survey of the alluvial soils of the Waimea County.

PUBLICATIONS

Chemical Investigations on Bitter Pit of Apples. I. Physical and Chemical Changes in Leaves and Fruits of Cox's Orange Variety during the Season. *N.Z. J. agric. Res.* 2:1167-1185. 1959. H. O. Askew, E. T. Chittenden, R. J. Monk, and Joyce Watson.

Nutritional Studies of *Phytophthora cactorum* (Leb. and Cohn.) Schroet. Part 2: Influence of pH of a Culture Medium on Utilisation of Some Nitrogen and Carbon Compounds. *N.Z. J. Sci.* 2:320-2. 1959. T. Christie.

Chemical Investigations on Bitter Pit of Apples. *Cawthron Institute Ann. Rep.* 1958-59:25-26. H. O. Askew, E. T. Chittenden, R. J. Monk, and Joyce Watson.

The Nutrition of *Phytophthora cactorum* (L. & C.) Schroet. *Ibid.* 27-28. T. Christie.

Water-culture Experiments on Nutritional Problems of the Tomato. *Ibid.* 29-31. E. B. Kidson.

Treatment of Tomato Seedlings with n-m-Tolylphthalamic Acid. *Ibid.* 32-34. D. J. Stanton.

Influence of Tomato Seedling Treatment on Flowering and Fruiting of Lower Trusses. *Ibid.* 35-37. D. J. Stanton.

- Pasture Investigations on Pakihi Land at Onekaka. Ibid. 38. E. T. Chittenden.
- Pasture Trials at Eight-eight Valley. Ibid. 39-40. E. T. Chittenden and K. J. Dobson.
- Aspects of the Cawthron Institute Museum. Ibid. 41-42. L. A. J. de Abaffy.
- The Taking of Soil Samples for Advisory Purposes. Ibid. 43-44. L. Hodgson.
- Fruit Investigations at Annesbrook Orchard, Nelson. N.Z. *Cawthron Institute Monograph No. 3*. 1959.

MASSEY AGRICULTURAL COLLEGE

Principal: Dr A. STEWART

PROJECTS

Agricultural Biochemistry—Calcification studies—wear in sheep's teeth; utilisation of carotene by animals; evolution of improvements in milk analysis; determination of the minimum frequency of sampling for obtaining significant data; study of the effect of variation in food intake and of factors affecting food consumption on the yield and composition of milk; interaction between amino compounds and sugars; and study of phospholipids in buttermilk powder and in bovine muscle.

Agricultural Zoology—Epidemiology of round worm parasitism in sheep; and distribution of bumble bee species in the South Island.

Dairy Husbandry—Study of endocrine factors in mammary gland growth; investigation of the Hooker Forbes method for estimating small quantities of progesterone in the blood of mammals; in cooperation with the Plant Chemistry Division and others, investigation of the effects of active material, which might occur in pasture species, on the animals consuming the pasture; the nutritive value of whey for fattening pigs; and studies of variation in food intake of some of the factors affecting food consumption and the effects of variation in food intake on the behaviour and performance of dairy stock.

Sheep Husbandry—Sheep breeding experiment; genetics of N-type horns; and carcass quality and meat investigation.

Soils and Field Husbandry—Pasture manuring under rotational grazing; and fate of fertiliser phosphate in Tokomaru silt loam.

Veterinary—*Leptospira pomona* vaccination in young calves.

PUBLICATIONS

- Wear in Sheep's Teeth. VI. Chemical Composition of Teeth of Grazing Sheep. *N.Z. J. agric. Res.* 2:1025-1040. 1959. C. R. Barnicoat.
- Comparative Survey of Romneys at Feilding and Gore Ram Fairs, 1959. *N.Z. Studmasters' Annual Review*. 37-38. 1959. R. A. Barton.
- "Quality Beef Production." 2nd ed. rev., pp. 112, by R. A. Barton. Published by Massey Agricultural College.
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- Recent Dairy Research Work in New Zealand. Part I. *Dairy Science Abstracts* 21:95-101. 1959. I. L. Campbell and R. M. Dolby.

Recent Dairy Research Work in New Zealand. Part II. *Ibid.* 27:137-143, 1959. I. L. Campbell and R. M. Dolby.

The Water Consumption of Lactating Dairy Cows at Pasture Under Temperate Conditions in New Zealand. *Proc. A.N.Z.A.A.S. Conference, Perth, 1959.* I. L. Campbell and R. E. Munford.

Selection for Relationships Opposite to those Predicted by the Genetic Correlation Between Two Traits in the House Mouse (*Mus musculus*). *Nature* 183:342-343, 1959. F. R. Cockrem.

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I—The Body Growth of the *N*-type Lamb. *Aust. J. agric. Res.* 10:387-399, 1959. F. R. Cockrem and A. L. Rae.

II—The Development of the Fibre Population. *Ibid.* 10:400-412, 1959. F. R. Cockrem.

III—Fibre Diameter and Medullation. *Ibid.* 10:413-423, 1959. F. R. Cockrem.

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An Approach to the Investigation of Face Cover in Sheep. *Proc. N.Z. Soc. Anim. Prod.* 1960. F. R. Cockrem.

The Effects of Feeding Wheys of Different Ages to Fattening Pigs. *N.Z. J. agric. Res.* 2:1111-1120, 1959. A. C. Dunkin.

Comparison of Chemical and Biological Estimations of Plasma Progesterone. *J. Endocrin.* 19:44, 1959. D. G. Edgar, D. S. Flux, and J. W. Ronaldson.

Progress on Experimental Work on Iodine and Anti-thyroid substances in Pasture Species. *Sheepfarming Annual 1959*:235-6. D. S. Flux, G. W. Butler, and A. L. Rae.

An Evaluation of Ammonium Fluoride as a Selective Extractant for Aluminium-bound Soil Phosphate—

I—Preliminary Studies on Non-soil Systems. *Soil Sci.* 87:13-21, 1959. C. V. Fife.

II—Preliminary Studies on Soils. *Ibid.* 87:83-88, 1959. C. V. Fife.

Gas-liquid Chromatography: Retention Volumes of the Methyl Esters of Fatty Acids with Special Reference to *n*-odd-numbered *iso* and (+) — *anteiso* acids. *J. Chromatography* 2:547, 1959. J. C. Hawke, R. P. Hansen, and F. B. Shorland.

A Note on a Comparison Between the Carcass Composition of Romney and Cheviot Mature Ewes. *N.Z. J. agric. Res.* 2:252-254, 1959. A. H. Kirton, R. A. Barton, and E. Cresswell.

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Some Effects of Thyroxine on Live Weight, Metabolism and Wool Growth of Romney Ewes. *N.Z. J. agric. Res.* 2:1143-1158, 1959. A. H. Kirton, E. Cresswell, F. R. Cockrem, and G. W. Butler.

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UNIVERSITY OF AUCKLAND

SEAGROVE RADIO RESEARCH STATION

Director: Dr H. A. WHALE

The station carries out research on the reception of overseas signals, in particular the angles of arrival of these signals. This yields considerable information on the global propagation of radio waves and on the structure of the ionosphere.

PROJECTS

An automatic bearing and elevation angle recorder is being operated at Invercargill to study the effect of the auroral region on long-distance radio propagation. This instrument will also be used to investigate the rapid variations in the direction of arrival of signals transmitted over short and medium distances.

A large rotating interferometer at Auckland is being used to determine the seasonal and diurnal variations in the direction of arrival of signals from different distances, with particular emphasis on antipodal propagation.

A smaller interferometer is used to record the bearing and elevation angles of radio signals received from artificial satellites to obtain information about the electron density in the upper ionosphere.

A rectangular array of 100 aerials has been constructed for the study of fading patterns and diversity reception.

PUBLICATIONS

- The Effects of Ionospheric Irregularities and the Auroral Zone on the Bearings of Short-wave Radio Signals. *J. Atmosph. Terr. Phys.* 13:258-270. H. A. Whale.
- Ray Paths in the Ionosphere. Approximate Calculations in the Presence of the Earth's Magnetic Field. *Ibid.* 14:50-62. 1959. J. E. Titheridge.

UNIVERSITY OF CANTERBURY

INDUSTRIAL DEVELOPMENT DEPARTMENT

Director: Mr T. R. POLLARD

The period under review has been the most successful year to date of this Department. The number of industrial projects handled each year has grown, rising from 200 in 1950, to 720 in 1958, and to approximately 800 in 1959. The recoveries from industry and various Government Departments totalled £13,000 as compared with about £12,000 in 1958.

During the periods 1956, 1957, 1958, I.D.D. was committed extensively to projects for the Antarctic and the extent of this work meant a reduction in research and development activities. The completion about 1958 of the D-layer project, for the Physics Department of the University of Canterbury for use at Scott Base, made the way clear for more research and development.

The major project completed in 1959 was the electrically heated blanket research. This work was sponsored by both the New Zealand Electricity Department and the manufacturers and importers of electrically heated blankets. This, together with the I.D.D. contribution, enabled work of national importance to be carried out and concluded successfully. This work took approximately 18 months and is covered in a 90-page report which has been circulated widely. Requests for the have come from both the United Kingdom and the U.S.A. As a result of this report the existing New Zealand Standard was altered immediately and a completely new draft of a specification is under review.

A considerable amount of the time of the staff of I.D.D. has also been taken up in advising the various manufacturers of blankets in New Zealand, who have paid numerous visits to I.D.D. Thus in this respect I.D.D. is fulfilling the purpose for which it was established.

A considerable amount of time has been given by members of the staff to the preparation of Standards for the New Zealand Standard Institute. This involves not only attendance at meetings but also discussion among staff and with manufacturers concerning draft proposals. No charge has been made for this work as it is considered an important contribution to the New Zealand economy. It has been found necessary to carry out tests to ascertain if their inclusion into a Standard will be satisfactory. Recently the Director of the Standards Institute has been given a small financial authority to cover the costs of the latter type of work.

A Metallurgical Section was established in 1959. A considerable amount of instrumentation has been necessary for this work, but, with the co-operation of the Physics Department with their new large Hilger spectrograph, it is possible to carry out rapid analysis on steel and steel alloys. Two high-temperature furnaces have been installed using crucilite heating elements, the larger furnace operating up to $1,200^{\circ}\text{C}$. The smaller tube furnace, operating up to $1,400^{\circ}\text{C}$, is used for carbon and sulphur determination with the Strohlein apparatus.

A humidity oven has been designed and made for various types of industrial testing. This works under an accurate temperature control up to about 85°C and under accurate humidity control up to humidities of approximately 90 per cent. This humidity oven has been in constant use for blanket testing.

The Industrial Development Department is still suffering from lack of space. It has not been possible to obtain sufficient room, either in I.D.D. or in the university, to house the blanket-testing machine and it has been necessary to place the machine in the New Zealand Electricity Department's substation at Islington. Every time a blanket is tested, the additional time involved adds about £5 to the cost. Also, there is no

suitable room for members to interview manufacturers. It is hoped that the university, supported by other authorities will provide the necessary accommodation at Ilam.

ROLLESTON RADIO FIELD STATION

Officer in Charge: Dr C. D. ELLYETT

The year 1959 has been the first full year of operation with American contract assistance. This has been used largely to meet the salaries of technical and computing assistants. In conjunction with some of the staff and research students of the Physics Department of the university, work has in consequence been carried forward at a much greater rate than was possible in former years. The grant from the Department of Scientific and Industrial Research has been used to maintain the running and the special equipment needs of the field station.

Meteor Research—The major aim of the programme has been to improve the equipment to the point where complete reliability in the hourly rates of meteors entering the Southern Hemisphere could be obtained over at least a year. Such results should be basic to many other investigations. All sorts of difficulties arose in obtaining this reliability and much new electronic equipment had to be constructed. Slow variations in the background radio-noise level proved especially troublesome, but these have now been successfully overcome by the design of a new type of amplifier capable of maintaining the output noise constant without affecting the meteor rate.

Results commenced in June, and by about the end of the year the desired reliability had been achieved. Very high Southern Hemisphere shower activity was present on 2 to 5 December, proving the annual nature of this stream, which had been detected by the older equipment.

D-region Research—The main equipment at the field station for obtaining echoes from the bottom of the ionosphere, at a vertical height of 30 to 60 miles, has operated on a restricted daily schedule throughout the year. A wealth of records was returned near the end of the year from the equipment at Scott Base, in the Antarctic, and at present the results from both sites are being processed. This type of equipment is beginning to give a clear picture, for the first time, of the amount of ionisation, and the movements, in the lowest portions of the ionosphere, and is a region of great current interest to both the meteorologist and the communications engineer.

Other Projects—Work is in progress on infrared radiation from the night sky, auroral radio noise, and micropulsations of the earth's magnetic field.

PUBLICATIONS

Sporadic E at VHF. *Proc. Inst. Radio Engin.* 47:762-769. 1959. R. M. Davis, E. K. Smith, and C. Ellyett.

Stratification in the Lower Ionosphere. *J. of Res. of the National Bureau of Standards D. Radio Propagation.* 63D:117-134. 1959. C. Ellyett and J. M. Watts.

Meteor Rates with Constant Parameters. *Air Force Cambridge Research Centre Report TN-59-964:1-13.* 1959. C. Ellyett, C. S. L. Keay, E. C. McLaughlin, and P. W. McNabb.

COMMONWEALTH AGRICULTURAL BUREAUX

The Commonwealth Agricultural Bureaux (C.A.B.), is one of the earliest established and one of the most successful organisations on a Commonwealth-wide basis in the field of science. Commonwealth Governments contribute financially to the support of this organisation and the world-wide sale of its publications augments its funds.

The principal functions of the C.A.B. are the preparation and publication of abstracts and monographs based on the world's scientific literature in the fields of agriculture, animal research, and forestry. These and the other services of the organisation enable research and extension workers to keep up to date with the very extensive literature and the rapid developments in these subjects. The organisation consists of 10 bureaux, three institutes, and a headquarters, all but one of which are located in the United Kingdom.

New Zealand is represented on the Executive Council of the C.A.B. by the Department's Senior Scientific Liaison Officer in London. Each bureau or institute is represented in New Zealand by an Official Correspondent who is a specialist in the subject concerned. The organisation as a whole is represented in New Zealand by the C.A.B. Liaison Officer, who is a member of the Head Office staff of this Department.

A review conference, held every five years, is attended by administrative heads of agricultural research throughout the Commonwealth and provides a special opportunity for a critical examination and review of the general policy, activities, organisation, and financing of the C.A.B. The next review conference will be held in London in September 1960.

APPENDIX

SECOND ANNUAL REPORT OF THE ROSS DEPENDENCY RESEARCH COMMITTEE

The Hon. P. N. HOLLOWAY, Minister in Charge of the Department of Scientific and Industrial Research.

I HAVE the honor to submit herewith the second annual report of the Ross Dependency Research Committee for the year ended 31 March 1960.

INTRODUCTION

During the second year of the Committee's activities, the Government's policy of maintaining Scott Base and carrying out scientific work in Antarctica has been continued. Further research investigations of national and international value have been initiated at the base, whilst geological, topographical, and biological surveys have extended our knowledge of the Ross Dependency region. The first phase of transforming the Scott Base facilities from an expeditionary base to a permanent scientific station has been carried out. Unfortunately, these achievements have not been accomplished without loss. On 19 November 1959, a sno-cat attached to the Geological and Survey Expedition fell down a crevasse in the Cape Selborne area. One man, Lt. T. Couzens, lost his life and two were injured, whilst the sno-cat was a total loss. On 15 January 1960, the Beaver aircraft of the RNZAF Antarctic Flight was destroyed when it crashed in the Beardmore Glacier region, without injury to personnel. These tragic accidents will retard the progress of the geological and topographical surveys of the Ross Dependency until replacement aircraft are obtained and positioned in Antarctica. To the relatives of Lt. Couzens the Committee extended its deepest sympathy. These losses have demonstrated most forcibly that Antarctic endeavour still is, and will always remain, fraught with danger. The authorities responsible for implementing the Antarctic programme have used the occasion to re-evaluate field-safety precautions which are taken to minimise these dangers.

Scott Base

During 1959, the scientific programme in the fields of ionospherics, aurora, geomagnetism, seismology, meteorology, and radio propagation was continued. Less emphasis was given to the intensive synoptic recording programme followed during the IGY and greater attention was devoted to research investigations in the ionosphere and auroral fields. The Geophysics Division and the Dominion Physical Laboratory, D.S.I.R., have the major scientific interest in the base programme.

Researches carried out during recent years at the University of Canterbury into the D-region, the lowest layer of the Ionosphere, were extended to the Antarctic to obtain comparative data at a high latitude. Organised by the university and financed by the Department of Scientific and Industrial Research, equipment installed during the 1958-59 season was successfully operated and produced extensive data which is being analysed by university staff. The equipment is being operated throughout 1960.

In auroral physics, the visual observation of aurorae carried out during IGY was discontinued. Using all-sky cameras and spectrographs, photographic (black and white, and colour) and spectrographic recordings of aurorae were obtained throughout 1959. During the 1959-60 summer season an auroral radar station was established at Arrival Heights, overlooking the United States McMurdo Station at Hut Point. This radar set, which will obtain reflections of auroral phenomena 500-1,000 miles to the north, is complementary to similar equipment at the Invercargill Auroral Station, which looks south. These two stations form part of a north/south chain extending from the South Pole station through Scott Base, Hallett Station, Campbell Island, Invercargill to Christchurch. Thus a complete cross section of the auroral zone circling Antarctica is obtained, enabling interrelated auroral, ionospheric, and geomagnetic information to be correlated in an endeavour to explain the true nature of the aurora and its effect on radio communications. The New Zealand auroral programme, which is the responsibility of the Dominion Physical Laboratory, is being carried out in cooperation with the United States which provides scientific equipment, whilst New Zealand provides men, equipment, and base facilities.

The 1959 base party was relieved during the 1959-60 season and replaced by a party of 14 to winter over during 1960. This includes two members of next season's field party who, in addition to technical duties, will look after the increasing dog population required to provide the dog teams essential to geological and mapping programmes.

During January 1960, HMNZS *Endeavour* resupplied the Base. Owing to adverse weather the relief operation was difficult but was eased by generous assistance freely proffered by the United States Naval Support Force which again transported from New Zealand the major proportion of the base fuel supplies. During 1959, the base maintenance engineers had a continuous struggle to maintain failing generating plant against an increased power load. This situation was relieved during the 1959-60 season by the erection of a new generator building, containing workshop and vehicle-repair bay, and the installation of new generators. For the support of the long-term geological survey and mapping programme the aircraft of the RNZAF Antarctic Flight require to be stationed at the Base throughout the winter so that they can operate early in the season before transport from New Zealand is available. Therefore, RNZAF with the support of D.S.I.R., secured authority for the erection of a hangar to accommodate the aircraft over the winter. The erection of a 60 ft $\times$ 60 ft steel-framed, plywood-sheathed hangar, was completed during the 1959-60 summer. Other base works were the erection of the auroral radar building and base building, and electrical maintenance work. This construction programme, which was undertaken by Ministry of Works with the assistance of an Army construction unit, is the first stage in the transformation of an expeditionary base to a permanent scientific station.

During the past season, accommodation and facilities were severely taxed by summer-season expeditions, specialist visitors, the Antarctic Flight, and the construction party. These conditions were accentuated by the continual but welcome flow of scientists, politicians, senior

Service officers, and leading Government officials from the United States, New Zealand, Australia, and other countries. Scott Base is a notable Antarctic station and attracts, over the summer season, several hundred visitors wishing to see its scientific installations and base facilities.

Hallett Station

For the third successive year, New Zealand provided in 1959 the staff of three to operate the scientific programme at this joint United States/New Zealand station. This example of international scientific cooperation has proved an amicable and profitable experience to the Americans and New Zealanders who have been at this isolated Antarctic outpost.

The appointment of the Station Scientific Leader alternates between New Zealand and the United States; for 1960, the Leader is a New Zealander. With his two fellow scientists, he took over from the 1959 party at the end of January 1960. The Americans have a scientific party of three engaged on meteorology and upper atmosphere physics and a support party of 11 Navy men.

The scientific programme follows closely that undertaken during the IGY and comprises continuous observations in the fields of ionospherics, aurora, geomagnetism, and seismology. Biological work undertaken during 1959 by one of the New Zealand scientists is reported in the section "Biological Investigations". The Geophysics Division and Dominion Physical Laboratory, D.S.I.R., and the Dominion Museum are the scientific institutions responsible for the scientific programme.

THE GEOLOGICAL AND SURVEY EXPEDITION

The long-term programme for this annual expedition is the geological reconnaissance and topographical mapping of the Ross Dependency. Within this sector lies one of the major mountain systems of Antarctica, stretching for over 1,000 miles from Cape Adare in the north and to the Beardmore Glacier and beyond in the south, along the western shores of the Ross Sea and the Ross Ice Shelf. This region of Antarctica contains major rock exposures and geological structures which can rightly be considered a New Zealand responsibility to explore and map. The New Zealand section of the Commonwealth trans-Antarctic Expedition and the 1958-59 Geological and Survey Expedition have completed surveys 150 miles north and south of Scott Base. The 1959-60 Programme envisaged surveys southwards from Barne Inlet to the Beardmore Glacier region by a party of eight men using three dog teams, supported by two sno-cats and the Beaver aircraft of the RNZAF Antarctic Flight. The sno-cat and the Beaver aircraft accidents depleted the field party from eight to five men by the death of one man and the injury of two others, and deprived the expedition of its major logistic support. Despite these losses, topographical surveys of approximately 4,000 square miles of territory between the Nimrod and Beardmore Glaciers were accomplished by a re-organised party of six men with three dog teams, with the substantial air support of the United States Naval Air Squadron. The experiences of the past season have

demonstrated that the most effective method of conducting this survey programme is with four-man units, each with two dog teams, supported by two aircraft each capable of transporting two men, a nine-dog team, sledge and supplies in one load.

THE VICTORIA UNIVERSITY OF WELLINGTON EXPEDITION

During the 1957-58 and 1958-59 seasons, university staff and students carried out intensive studies in the dry valley systems found on the western side of McMurdo Sound, from the Taylor Valley northwards to the MacKay Glacier. These ice-free valleys have provided unique opportunities for geological, biological, and meteorological studies. During the past season, the third and final expedition to this area was successfully carried out by a University party of five men. The party was transported to the area from Scott Base by United States Navy helicopter during the latter part of November 1959 and was withdrawn by the same means early in February 1960. It comprised a biologist, geologist, and three geology students, accomplished extensive work in many scientific disciplines, and completed topographical surveys of the whole area.

THE NEW ZEALAND ALPINE CLUB EXPEDITION

After extensive negotiations between the Ross Dependency Research Committee and the Alpine Club to arrive at a mutually acceptable plan for an expedition having clearly defined scientific objectives, it was agreed that an eight-man expedition should explore, map, and carry out geological reconnaissance in unknown territory lying to the east of the Beardmore Glacier. In mid November 1959, the eight-man party, with supplies and manhauling sledges, was flown by United States aircraft to the United States Beardmore Depot at the foot of the Beardmore Glacier. Manhauling their sledges across the ice shelf to the coast line 30 miles to the south, the party began the heavy task of travelling up an unnamed glacier into the unknown interior. The expedition penetrated 45 miles to latitude $84^{\circ} 19' S$, and mapped approximately 1,200 square miles of unknown territory. It withdrew to the Beardmore Depot in January and was flown back to Scott Base by the Beaver of the RNZAF Antarctic Flight. The successful completion of this expedition demonstrated what mutual understanding and cooperation in Antarctic endeavour can achieve.

SOIL SURVEY PARTY

Certain areas of Antarctica present unique opportunities to study the fundamental processes of soil formation under glaciated conditions. Such areas on the western side of McMurdo, up the Taylor Valley in the same region, around Ross Island and at Hallett Station, were studied by two soil scientists from the Soil Bureau, D.S.I.R., during the past season. The chemical and physical processes taking place were studied *in situ* at many places and numerous samples were brought back to New Zealand for further analysis. Transport to areas round McMurdo Sound was provided by Scott Base, whilst United States air transport was made available for the visit to Hallett Station.

BIOLOGICAL INVESTIGATIONS

Biological work was carried out at two localities. At Hallett, one of the New Zealand scientists conducted extensive biological studies during the autumn 1959, and over the summer 1959-60. The main effort was directed towards general surveys and population studies of the Adelie penguin rookery at Hallett, which numbers approximately 100,000 during the height of the season. On 19 August the biologist, with a party of four Americans, made an abortive attempt to reach the extensive Emperor penguin rookery on Coulman Island during the nesting season. Travelling in two Weasels the expedition was abandoned on the second day out when the leading vehicle went through the sea ice and sank in a few minutes, leaving the occupants scant time to leap to safety on the adjacent ice edge.

At Cape Royds, adjacent to Shackleton's hut, a small Adelie penguin rookery of 2,500 birds and a very much smaller colony of Skua gulls live in close proximity during the summer season. The Skuas derive some of their sustenance by preying on the penguin chicks and eggs. Throughout the 1959-60 summer two biologists were stationed at Cape Royds, living in Shackleton's hut, to observe the relationship between and within two communities of birds living in a simple environment. The complete mating, nesting, chick rearing, and return to sea, cycle was observed for both colonies and original biological data have been obtained by these two investigations.

The Dominion Museum has scientific responsibility for the biological work.

OCEANOGRAPHIC AND SEA SEISMIC SURVEYS

Oceanographic surveys between New Zealand and Antarctica and in the Ross Sea were continued, and for the first time sea seismic soundings were attempted in the Ross Sea.

During October 1959, a party of four oceanographers from the N.Z. Oceanographic Institute, aboard HMNZS *Endeavour*, planned to study the Campbell Plateau extending southwards from New Zealand through the Auckland Islands to Campbell Island and the Macquarie/Balleney Ridge extending southward to the Antarctic continent. A number of these underwater "mountain ranges" extend out from the Antarctic continent. The ocean circulation and bottom fauna and flora along these "ridges" is of considerable importance to oceanographers and marine biologists in their studies of Antarctic waters. Although the *Endeavour* was unable to proceed as far south as planned, worthwhile results were obtained as far south as Campbell Island.

After HMNZS *Endeavour* had resupplied Scott Base early in January 1960, she took a party of six oceanographers and geophysicists on a series of cruises into the Ross Sea. The objective of the oceanographic work was to study changes in the bottom fauna and flora in the Ross Sea from the Pennell Bank, where depth of water is approximately only 100 fathoms, down to the continental shelf in a north-easterly direction, to a depth of 2,000 fathoms. A large number of oceanographic stations were kept, at which an extensive range of bottom-living animals was obtained, whilst underwater photographs of the bottom were taken in

several places, particularly on the Pennell Bank at a depth of 135 fathoms. Similar work was carried out in the McMurdo Sound area. The N.Z. Oceanographic Institute, D.S.I.R., has scientific responsibility for this work.

The objective of the geophysicists' work was to study the rock structure of the sea bottom in the Ross Sea. Techniques similar to those used in oil prospecting were employed. Charges were exploded in the sea near the surface at regular intervals along a predetermined course. The reflections from the sea bottom of the shock waves from these explosions were picked up on several geophones attached to sonobuoys moored along the course. These reflections were transmitted by radio from the sonobuoy to the recording equipment aboard *Endeavour*, and from the records obtained deductions as to the nature of the sea bottom are possible. As this was the first time that this technique had been employed in Antarctic waters, the operation was in the nature of an experiment and perfect results were not anticipated. The results obtained were, however, promising and showed that the method was feasible under rigorous Antarctic conditions. The Geophysics Division, D.S.I.R., which has scientific responsibility for this work, proposes to attempt further soundings during the 1960-61 season.

In addition to these studies, a proton-magnetometer was carried on *Endeavour* to enable continuous total-force magnetic surveys to be carried out during the Antarctic cruise of the *Endeavour*.

ANTARCTIC DIVISION

The Antarctic Division of the Department of Scientific and Industrial Research was established early in May 1959. It is charged with the executive responsibility of implementing the Antarctic Programme. The 1959-60 Programme was successfully put into operation by the Division and the step taken by the Department to unify control of Antarctic activities and expenditure under one Division has been fully justified.

INTERNATIONAL RELATIONS

Close international cooperation continues to be a strong feature of Antarctic activities. The free interchange of information and scientific data, and the exchange of scientists on Antarctic projects are being carried forward by most countries participating in Antarctic work. Nowhere is the spirit of cooperation more evident than in the New Zealand/United States relations. The United States Naval Support Force has continued its generous assistance to our operations and particularly was this evident during the mishap to the *sno-cat* and Beaver aircraft when the United States Naval Air Squadron gave invaluable aid. At the scientific level, there is continuous collaboration between scientists of both countries working in Antarctica and between their counterparts in New Zealand and America. Scientists in other countries have shown similar interest in New Zealand Antarctic work and where possible have visited Scott Base to discuss the scientific work in progress.

From 17 to 25 November 1959, the Argentinian Government, through its Antarctic Institute, held a Symposium on IGY Antarctic activities. At its invitation and expense it invited to the Symposium two delegates

from each country working in Antarctica. New Zealand was able to accept this generous invitation by sending Dr T. Hatherton, Geophysics Division, D.S.I.R., who was the Chief New Zealand Scientist in Antarctica during the IGY, and Mr K. J. Salmon of Civil Aviation Administration, who was Station Scientific Leader at Hallett Station during 1958.

PUBLICATIONS

Appended is a list of scientific papers on New Zealand Antarctic Research, published by New Zealand scientists during the past year.

ACKNOWLEDGMENTS

The Ross Dependency Research Committee and the Antarctic Division, D.S.I.R., have received generous support from many quarters during the year and this report would be incomplete without acknowledgments to United States Naval Support Force, Antarctica, for unfailing and unstinted support of New Zealand Antarctic operations; to the Royal New Zealand Navy, Royal New Zealand Air Force, and New Zealand Army, for generous logistic support of sea and air operation, and in base construction work; to the Ministry of Works, for invaluable assistance and advice on building construction at Scott Base; and to the Victoria University of Wellington Antarctic Expedition, and N.Z. Alpine Club Expedition, 1959-60, for generous assistance in camp duties and construction work whilst living at Scott Base.

R. G. SIMMERS, Chairman,
Ross Dependency Research Committee.

N.Z. ANTARCTIC RESEARCH PUBLICATIONS DURING THE YEAR ENDED 31 MARCH 1960

General

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Geological Investigations in South Victoria Land, Antarctica: Part I - The Geology of Victoria Dry Valley. *Ibid.* 2 (1):120-136. 1959. P. N. Webb and B. C. McKelvey.

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Gravimetry

Gravity Observations in the Wright Valley Region of South Victoria Land, Antarctica. C. Bull (in press).

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